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Suggestion to Develop Niagara Falls' Full Efficiency

By an Overseas Engineer Officer

NIAGARA FALLS is the greatest joint National asset belonging equally to Canada and the United States. There are two vital points which must be safeguarded by each country, individually, in the future development of water power. The most important is that power shall be developed only at the maximum possible efficiency—that is, that the highest static head possible on the turbines shall be secured; and, as the total head between Lake Erie and Lake Ontario is 326 feet, the construction of the head works should provide for maintaining the water up to this level. The loss of even one per cent efficiency in the total available for a period of 100 years would be very serious, and it is a fault extremely difficult to correct once a plant is built.

Next in importance is to maintain the Falls so that the next generation may have the same privilege as we have all enjoyed.

How Maximum Efficiency May Be Secured

The way to develop more power at Niagara Falls with the ultimate possible efficiency and at the same time maintain the present beauty of the Falls is as follows:

To dam the Niagara River above the Falls and maintain the water at the level of Lake Erie.

To use a net head of at least 312 feet. (326 total.)

To construct a single power development on the Canadian side of the river, owned equally by the United States and Canada.

This would secure the desired results, providing maximum efficiency, the lowest possible cost per horse-power and maintenance of the present beauty of the Falls. To explain in detail:

It is proposed to build a drum, sluice-gate type of dam from the Ontario Power Company's intake on the Canadian side to the head of Goat Island on the American side. The openings between the gates would be 100 feet wide, and the total section would be ample to pass greater floods than any of which there are record. Since the water is not over ten feet deep, the construction of the necessary cofferdams would present no difficulties. The foundations would be pressure grouted.

On the Canadian side of the Falls the banks are uniformly high, but on the American side a low dike would have to be built for some distance up the river, with a lock entering the Erie Canal. An ice boom would be placed across the mouth of the river at the close of navigation, to prevent ice entering the river in the spring. By the operation of the sluice gates in the dam, the water would be maintained at the mean level of Lake Erie summer and winter.

To secure water to operate the power plant 24 hours a day and to maintain the beauty of the Falls, the gates in the dam would be shut from 8 P. M. to 8 A. M., or during other suitable hours; and, if 200,000 cubic feet of water per second were stored for 12 hours this would be sufficient for the development of 2,800,000 electrical horse-power, with 80 per cent efficiency.

We would therefore have the Falls running even fuller than at present for 12 hours, and perfectly dry for 12 hours; which would be as interesting a sight, in its way, as a view of the Falls itself.

The reason why only 312 feet could be utilized out of a total of 326 feet is that the entrance to the penstocks would be several miles from Lake Erie, and it requires a certain amount of head for the water to flow from the lake down the canal, even though it moved very slowly. To secure a 326-foot head would involve a canal width and expense out of all proportion to the results obtained.

Greatly foreshortened view of Niagara River, showing plan for utilizing, at maximum possible head, all the water now passing over the Falls

At night when the plant is running at full capacity the Falls will be dry

A joint power development by the United States and Canada would have many advantages over two separate developments. The whole work would be under one joint commission; there would be only one diversion of water; the speed of construction would be greater, and the total cost per horse-power would be less, because the one set of plans would do for the successive developments, and the same type of hydraulic and electrical machinery would be used throughout. The low cost and ease of operation would be decided factors in governing the price of power.

The Canadian side of the river from, the viewpoint of the ease and cheapness of construction, is superior to the facilities on the American side; but the chief factor is that with a joint development, only one right-of-way would have to be purchased. A right-of-way on the American side would pass through several miles of expensive residential districts, while on the Canadian side the canals would run through farm lands.

The main canal would be the Welland River, widened for a distance of three or four miles to the point where the upper head gates into the various canals would be located.

The smaller canals would have a capacity to deliver water for about 500,000 horse-power, and they could be drained separately for inspection and repairs. Each development of 500,000 horse-power would be complete in itself, and would therefore consist of the canal, headworks, penstocks, and the power house; but probably a joint tailrace would be found advisable.

The Objections

The chief objection is the sentimental one, that each country would naturally wish to develop its own power; but for many years most of the power used on the American side of the river has been developed in Canada, and there is no reason why the arrangement should not continue. If our boys can fight side by side in France, they can work side by side when they return, and a big public work like this would give work for many thousands of them.

The Hydro-Electric Power Commission of Ontario

Sir Adam Beck, Chairman of the Hydro-Electric Power Commission of Ontario is the father of cheap power in America. In a few short years he has built the greatest high and low tension systems owned by the people in the whole world and has given them the cheapest power. Five years ago, Sir Adam started to develop water powers until today he is constructing a power plant to develop a quarter of a million horse-power with a head over 300 feet high near Niagara Falls, as outlined above. His work has been a success from every point of view—engineering, financial and service. His watchword is Efficiency, and he would welcome anything that would increase the efficiency and maintain the present beauty of the Falls.

But it would mean comparatively little change in the plans to make this initial development 500,000 horse-power instead of 250,000 horse-power; and this would be the quickest way to secure the additional power so urgently required for the operation of war industries within transmitting distance of Niagara.

Later on, by utilizing the water now being used by the private power companies, at a head of over 300 feet instead of at their present head of 135 to 180 feet, the Government could return to the companies an amount of power, equivalent to that which they generate now at their present cost of operation, and at the same time have an equal amount for delivery to the people, all from the same amount of water; and this because the water would

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The German "Flying Tank"

EVER since the gray hosts of Germany rolled over Belgium and northern France like an irresistible tidal wave, only to dash against the breakwater of Allied resistance at the Marne, the civilian world has feared and placed too much stock in German ability, especially scientific ability. Time and again the Germans have been credited with accomplishing the next to impossible; innumerable times the civilian world has felt that the Germans had introduced such formidable weapons that counter measures could not prevail. And all this because Germany, above all, is a master press agent of her accomplishments; in fact, it is part of the military purpose to frighten and discourage the enemy. With this in mind the Teuton introduces some new idea from time to time, and not only is the achievement press-agented to the farthest corners of the world by his own propagandists, but the press correspondents of Allied and neutral countries seize upon this opportunity to write column after column of reading matter. So, the war seemed lost when the Germans introduced poisonous gases; when the Germans first used liquid fire; when the Germans first employed their heavy guns against permanent fortresses; when the U-boats were loosed upon merchant ships; and now when the "flying tank" has appeared.

Starting a month or so ago, rumors began to filter back from the Western front, telling of the wonderful aerial achievement of the Germans—a tank that is heavily armed and armored, and that flies like an airplane. Then came the lamentable death of Major Lufberry of the American aerial forces, who met his end while engaged in a combat with a German "flying tank." And now the civilian world is again greatly concerned over what appears to be a formidable weapon against which our own are impotent.

Fortunately, aeronautical experts and military men scoff at the idea of an invincible German airplane. They know that even at the beginning of the war there were so-called armored battleplanes in use. To be sure, these armored machines only carried a thin sheet of steel on the bottom of the nacelle or fuselage so as to protect passengers and engine from rifle fire from below. That was before airplanes carried machine guns, and the only danger was from the ground. Later, when machine guns came into use on flying machines, aircraft constructors attempted to extend the use of armor so as to protect engines and passengers, but little success has been achieved along this line. It is as true of the airplane as of the soldier: we could equip the infantryman with a suit of armor that could deflect rifle bullets; but the weight would be so great that the advantage gained, except for storming troops, would soon be nullified by the loss of mobility. So with the airplane; the margin of weight that can be carried over and above that required for the engine, fuel, guns, ammunition and passengers, is so slight that no appreciable amount of armor can be provided except at the expense of absolute essentials. Even a thin coat of armor adds so much weight that the speed is reduced to 60 per cent, and the airplane loses the great mobility and climbing power, which make it proof against anti-aircraft artillery and in ninety-five cases out of one hundred against hostile airmen.

The German "flying tank" is described as a rather large biplane in which the pilot sits in a casing of three-eighths inch steel, and the vital parts of the machine are similarly protected. In addition to the pilot, two gunners are carried, leaving the pilot to manage the machine. The guns command the air in all directions, making it difficult for hostile airmen to attack; furthermore, machine-gun bullets are said to be without effect on the steel casing.

It would seem, in the absence of further facts, that the Germans have simply sacrificed speed and climbing ability for armor protection, and that against the usual battleplanes using ordinary ammunition the "flying tank" is more or less immune except for an occasional shot that finds a vulnerable spot in the armor. However, our French allies long ago foresaw this danger, and accordingly provided what is known as the *avion-canon* or cannon-plane. This machine, which is of the Voisin type, made its appearance during 1916. It mounts a 1½-inch rapid-fire cannon and is being used in considerable numbers to guard Paris against Gotha raiders. The *avion-canon* is too slow and too poor a climber to compete with fast German battleplanes; yet, it would seem ideal against the equally slow "flying tank." And its stream of 1½-inch armor-piercing shells can be counted upon to puncture the German's armor without the slightest difficulty.

There is still another counter-measure available. Some time ago in these columns we referred to the special bullets designed by our ordnance officials for the use of our airmen, among them being an armor-piercing bullet. This bullet, containing a hard steel core in a soft metal jacket, no doubt could penetrate such armor as may be carried by the German "flying tank." If not, the emergency can certainly be met by designing special bullets for the latest elephantine creation of the German mind.

Lastly, the "flying tank" should fall an easy victim to anti-aircraft gunners. So great has the proficiency of aerial artillerists become, that even the fast airplanes are often brought down. The slow-moving armored airplane, flying at a comparatively low altitude, should present a most favorable mark to anti-aircraft guns scattered throughout the battle area. That fact alone, in the absence of more definite information, points to the limited efficiency of the German "flying tank."

At any rate, unless the Germans have really introduced a definite innovation in aircraft design, the "flying tank" is but another of their unsuccessful attempts to gain the upper hand on land and sea and in the air. But in the meantime it makes excellent reading matter.

Closing the North Sea

FOLLOWING closely upon the announcement of the recent successful raids upon the German submarine bases at Zeebrugge and Ostend, comes the announcement by the British Admiralty of a "prohibited area in the North Sea, which is dangerous to all shipping." The area is defined in terms of latitude and longitude, and the tremendous significance of this announcement might easily be missed. As a matter of fact, the prohibited stretch of ocean is represented by a vast triangle about four hundred miles across its base, which reaches from the coast of Scotland to Norway, and whose sides sweep north into the Atlantic for a distance of six hundred and fifty miles. The contained area is one hundred and twenty-two thousand square miles.

The announcement, earlier in the war, of similar, though of course, much smaller prohibited areas, has been accompanied by a statement that these areas had been sown with mines. Two of the largest of these were laid at the Straits of Dover, and in the Bight of Heligoland. Therefore, it is quite reasonable to assume that Great Britain has covered this triangle, also, with mines, and that they have been laid in such numbers and at such varying depths, that it will be impossible for the U-boats to pass into and out of the North Sea without being destroyed.

We notice, by the way, that the Naval critic, Archibald Hurd, in the course of a lengthy article on this mine field, published in the *London Daily Telegraph*, has this to say:

"The secret has been well kept, unless the enemy drew his own deductions from a series of articles which appeared in the SCIENTIFIC AMERICAN almost exactly a year ago. Those articles suggested that the writer had some inkling of the policy which the Admiralty were adopting."

As a matter of fact, the articles referred to were written at a time when the U-boat depredations were at their height and the attack was gaining upon the defense, and it was evident that some radical methods must be found for meeting the emergency. What we did advocate was the closing of the North Sea by a net, laden with mines, stretching from the coast of Scotland to the coast of Norway. It was our belief at that time that the many failures of nets were due to the fact that they had been built too lightly, and that if steel cable of sufficient weight were used, a net could be built and maintained in place, even across the two-hundred-and-fifty-mile-stretch of water between Scotland and Norway.

We had come to the conclusion that to attempt to cover all the submarine-infested seas with patrol boats was impossible because of the vast numbers required, and we stated the situation at that time as follows:

"If this murderous piracy is to be wiped out we must adopt the opposite and obvious policy of blocking the submarine fleets at their point of exit and fighting them within their own waters. This may be done in two ways. We may institute a coast blockade by building continuous nets across the entrances to Zeebrugge, Wilhelmshaven, the Elbe, and the Baltic, or we may surrender the North Sea entirely to the German submarines and shut them within it by a wall of obstruction across the English Channel at Dover and across the North Sea from Scotland to Norway."

We did not believe that anything short of a net would present an effective barrier; and it was certainly far from our thoughts at that time that the British Government would contemplate the closing of the North Sea by such prodigious mining operations as they now seem to have carried out. Certainly, we had no "inkling" of the policy which the Admiralty were adopting, and we confess to positive amazement that it should have proved possible to build a mine field covering a hundred and twenty-two thousand square miles of ocean. Evidently, the thing has been done. How closely the mines have been spaced must be a matter of conjecture; but it is certain that the U-boat which attempts to cut across this field, except in a latitude many hundreds of miles to the north of Scotland, will have to pass and risk contact with several hundred to several thousand mines.

Women on the Land

LAST summer the Vassar College farm of 740 acres was short-handed. Volunteers were called for from among the student body, and 12 girls were finally chosen to spend the summer at the farm as laborers. They worked on an average eight hours per day; they performed every kind of labor done on the farm, including traction and horse plowing, harrowing, planting, cultivating, weeding, thinning, hoeing, potato planting, berry picking, mowing with scythe and with machine, hay raking and pitching, reaping, shocking grain, making fences, and milking; they stayed through the summer and finished in better health than when they started. In deference to the opinion of the men, who claimed that the girls could not do the same work that they did, the hourly wages for the girls were fixed at a slightly lower figure than for the men; but at the end of the year the men admitted that this had been an injustice, and that the girls should have had the full wage.

A group of women students of the Manhattan Trade School, with a number of Barnard College undergraduates and alumnae, formed a "women's agricultural camp" in Westchester County. The girls were paid a weekly wage by their own organization, and by it supplied to the farmers of the locality at 25 cents per hour. At first the farmers looked with extreme suspicion upon the enterprise. But after grudging trials had made the entering wedge, the girls made good with such a vengeance that the demand very soon exceeded the supply.

In both the cases cited the girls were quite without previous farm training. The point proved on a small scale by these and other isolated demonstrations, an organization has this year been formed to provide women agricultural workers in a more pretentious fashion. This is the Woman's Land Army of America, of 32 Fifth Ave., New York City; or any County Farm Agent can give the necessary particulars.

The general plan is to send out units of workers to any farmer who applies for them. A unit is of any size desired, from four to seventy; it is wholly self-contained, living in vacant houses, barns, or tents, under the care of its own chaperone-housekeeper. The women are farm laborers by the day, not boarders; they provide their own food and cook it themselves. While untrained, they have passed a physical examination; and any farmer, it is pointed out, can teach them enough in ten minutes to keep them busy for a week.

Last year there were nine units of this sort in the field, independently. They were made up mainly of college students and workers in seasonal trades in which the summer is the dull season. In our opinion there cannot be too hearty a response to this movement, either from the farmers or from the workers. England has shown what women can do on the land; last summer we showed that our women are potentially as important factors in crop production as are their British sisters. The organization which has been formed seems by all means the intelligent procedure for bringing woman labor to the farms in this country. It has our best wishes.

Canada's Ambitious Shipbuilding Plans

CANADA has entered upon an ambitious program of shipbuilding, as a result of the decision of C. C. Ballantyne, minister of marine and fisheries, to help meet the shortage of shipping in the Atlantic trade, according to press despatches from Ottawa. Plans have been made for the construction of a plant for rolling steel plates with an output sufficient to meet the demands of the shipyards of the Dominion for years to come.

The Canadian Government will obtain supplies of plates and angles necessary for this steel construction program from the United States. This is made possible by the efforts of the United States Government, the War Purchasing Commission, and the Federal Trade Commission. Already orders have been placed in this country for 80,000 tons of steel for ship construction. The same prices prevail as are paid for the same materials by the United States Government.

The new steel plant will be erected at an expenditure of from three to five million dollars, and will be ready for operation in from fifteen to eighteen months. The plant is being built by the Dominion Iron and Steel Corporation, and is receiving no direct financial aid from the government.

Aeronautical

Siam's Contribution to Allied Cause.—An aviation corps of 500 members will be Siam's contribution to the Allied cause, according to Frank D. Arnold, formerly charge d'Affairs at Bangkok, who recently arrived in this country. "The Siamese army has developed some splendid aviators," says Mr. Arnold. "They seem to take naturally to the work under the instruction of French and Italian experts. When I left they were preparing to send over 500 men with a complete quota of airplanes, all of foreign construction."

The Berckmans Speed Scout.—That America is capable of designing and building speedy single-seater airplanes for battle service is evident from the Berckmans speed scout, recently put through rigid tests with the most satisfactory results. Piloted by Bert Acosta, this little machine ascended to 22,000 feet and returned to the earth in 27 minutes. The general specifications of this interesting little machine are as follows: Span, upper plane, 26 feet; span, lower plane, 19 feet; chord, both planes, 4 feet 11 inches; gap, 5 feet 3 inches; stagger, 17 degrees; length of machine overall, 18 feet; height of machine overall, 8 feet 9 inches; net weight, empty, 820 pounds; gross weight, loaded, 1,190 pounds; useful load, 370 pounds; engine, G. V. C. Gnome rotary, seven cylinders, 100 horse-power; speed range, 115-54 m.p.h.; climbing speed, 1,100 feet per minute; gliding angle, 8 to 1; radius of action, 2½ hours.

Mountain Flying.—Dr. A. M. Kellas, the well-known scientific mountaineer, lectured on March 18th last before the members of the Royal Geographical Society under the presidency of Dr. Hugh Mill, on "The Possibility of Aerial Reconnaissance in the Himalaya." The range, he said, had only six peaks above 27,000 feet high, and an aviator flying at about 23,000 or 24,000 feet should have no difficulty in crossing if the highest peaks were avoided, while, if he chose certain of the gorges, an altitude of some 19,000 feet would suffice. The greatest of the many obstacles to be encountered was the mountain sickness which occurred in the highest altitudes through deficiency of oxygen. The gradual climber, going afoot, was less handicapped in this respect than the aviator rising suddenly from sea level in his machine; on the other hand, the pedestrian had more fatigue to undergo, and this practically equalized matters. The chief desideratum, in any case, was an adequate supply of oxygen with a proper inhaler.

Death of Captain Resnati.—While starting on a flight in a big Caproni biplane, Captain Antonio Silvio Resnati of the Royal Italian Flying Corps met his death at the Mineola aviation grounds on May 17th, last. The cause of the accident is not definitely known; at first it was thought that the big biplane might have been tampered with by pro-German agents or sympathizers, but subsequently it was stated that Captain Resnati, having only recently recovered from a severe illness, was not quite in full possession of his usual flying skill. The machine side-slipped from a height of but 100 feet, and the wreckage crushed the unfortunate aviator. The funeral was of an official and most impressive nature. The body was brought to New York City on May 21st, carried up Fifth Avenue to St. Patrick's Cathedral with an escort of American and Allied officers and officials, and the 225th Aero Squadron. While the funeral procession solemnly marched up Fifth Avenue, a big Caproni biplane overhead flew back and forth, in full view of everyone. At times the airplane dipped down to within 100 feet of the tall buildings, with a roar that completely drowned out the funeral bands.

Wanted: Steel and Variable Pitch Propellers.—The National Advisory Committee for Aeronautics desires to invite the attention of all designing engineers, and particularly those interested in propeller design, to two very important problems now confronting the air services of the Nation, namely, a steel air propeller and a variable pitch air propeller. The Special Subcommittee on Engineering Problems has reported that these problems have been under consideration for some time but so far without attaining satisfactory results. These problems require careful mathematical study by technicians fully equipped with a sound understanding of the fundamental principles of aeronautical and structural engineering. The ideal variable pitch propeller should embody means for changing simultaneously the diameter, area, and pitch for changes in air density. It is not necessary that design of the steel propeller follow the present practice in wooden air propellers, but after careful consideration has been given to the aerodynamical principles involved, design and experimental work should follow fundamental structural engineering practice. The development of such propeller should be coincident with the development of the variable pitch propeller. Aeronautical engineers and other technicians are invited to give thought to this problem and submit brief descriptions of their ideas with such drawings, data, and photographs as are necessary, to the National Advisory Committee for Aeronautics, Munsey Building, Washington, D. C.

Science

Cottony Cushion Scale in Ceylon.—The conquest of the cottony cushion scale insect (*Icerya purchasi*) in the citrus groves of California by the ladybird beetle (*Novius cardinalis*), introduced for that purpose from Australia, is one of the chief landmarks in the history of fighting insect pests by means of insect parasites and predators. It is therefore, interesting to learn that this destructive scale has recently acquired a firm foothold in Ceylon, where it is devastating not only citrus trees, but a wide range of other useful plants. The government of India is alarmed lest the insect invade that country also, and has inaugurated a scientific inquiry as to preventive measures.

Annual Tables of Constants.—The bulky volumes of physical and chemical data known as "Tables Annuelles de Constantes et Données Numeriques" began with the volume covering the year 1910, and two subsequent volumes had been published up to the outbreak of the war. No publication has since been possible, but the collection of material has been continued under the direction of Dr. Charles Marie, general secretary of the permanent commission having the matter in charge, and the following members of the commission: Carrara (Milan), Cohen (Utrecht), Dutoit (Lausanne), Lewis (Liverpool), and Stieglitz (Chicago) French, British and American grants in behalf of this undertaking have been continued and increased during the war.

Need of Bird Protection in Great Britain.—Commenting on a letter to the *Times* in which the Duke of Rutland urges the protection of insectivorous birds, *Nature* states that since the beginning of the war tens of thousands of acres of woods and forests have been destroyed in the British Isles, and this is likely to result in a large decrease in the number of insectivorous birds. As, at the same time, the stumps of recently felled trees provide an ideal breeding ground for insects, an insect plague seems to be in prospect. Moreover, the severe winters of the past two years have destroyed an immense number of tits, flycatchers, warblers, etc. The need is, therefore, more urgent than ever for the adoption of measures to protect such birds, including the establishment of an official bureau of ornithology.

Migration of Mosquitoes.—Some surprising facts regarding the migrations of mosquitoes and other insects have been discovered by Prof. S. C. Ball, who spent a month at Rebecca Shoal lighthouse last summer. This lighthouse is isolated in the ocean, 12 nautical miles from the nearest land, which is East Key, Tortugas, while the nearest region on which any considerable number of mosquitoes can breed is Marquesas Atoll, 24 miles distant to the eastward. Breezes from the north and east brought mosquitoes to the lighthouse, and in one case a strong southerly wind brought them from Cuba, 95 miles away. Indeed, in some instances there was evidence that they were brought by favorable winds from even more distant points; perhaps from Tampa Bay, 180 miles distant! House flies and various other insects were also captured at the lighthouse.

The Index Medicus in Wartime.—The latest report on the compilation of the Index Medicus states that the file 1or 1916 contains 830 pages, as compared with 1,448 in 1913, 1,311 in 1914, and 1,011 in 1915. In other words the shrinkage in this international bibliography of medicine in the first two years of the war amounted to more than 42 per cent. After the beginning of 1915 German medical literature was not fully accessible to the compilers, though through the courtesy of certain medical societies and libraries a fair proportion of such literature was indexed to the end of 1916. Subsequent German literature will probably be inaccessible until after the war. It is noted that France, Italy, Spain, Scandinavia and Spanish-America have kept up their full quota of medical literature. One Belgian medical journal, the Archives Médicales Belges, was revived during 1917.

Investigations on Vesuvius.—The current report of the Carnegie Geophysical Laboratory contains a brief account of a descent into the crater of Vesuvius made last August by Dr. Malladra and Mr. F. A. Perret, for the purpose of comparing conditions with those observed at the time of their last previous descent, in August, 1916. The night was spent at the bottom of the crater, the entire stay being 15 hours. The eruptive conelet was found to be at the same height above sea-level, but the crater bottom had been greatly filled up around it by lava which had flowed from it and from a second conelet, new since the previous inspection. In the conduit of the main conelet the lava now boils quietly, with an occasional ejection of liquid fragments. The general condition of the crater bottom is quite Hawaiian, with hummocks covered with lava splashes and some enormous intumescences, which have lifted the crust of the floor to heights of 10 meters or more. The report states that the lava filling the great crater has now reached a sufficient height to make possible the initiation at any moment of an external lava flow, such as characterized the last eruptive period (1875-1906).

Automobile

Motor Trucks and the Farmer.—While a good motor truck is often considered an expensive investment it is without doubt an extremely profitable one for any farmer who produces on a fairly large scale. This is clearly demonstrated by the experience of a farmer in California, who has to haul his fruit and produce 30 miles to the railroad. Whereas it took his horse-drawn team two days to make a single round trip, with his motor truck he makes two round trips a day. Any practical man can readily figure out the economy resulting from the use of a good truck.

"Gasoline Intensifiers" for Automobiles.—The last annual report of the Bureau of Standards refers to certain materials on the market known as gasoline intensifiers, for which the claim is made that when added in small quantities to gasoline an increased engine efficiency is secured. The Bureau has tested six of these preparations, and also a sample of gasoline alleged to be treated by a secret electrochemical process. A six-cylinder automobile engine, driving an electric absorption dynamometer, was used in the tests, and though this apparatus was highly sensitive no increase in power could be detected as a result of using the so-called intensifiers or the treated gasoline.

Cleaning Carbon from Cylinders.—Everyone who has performed the tedious task of scraping the carbon from the cylinders of an automobile engine knows how difficult it is to get all the loose carbon out, and the serious results of leaving any stray particles, or gritty dust in the crack around the pistons, or in the various passages. A writer in an English publication gives a useful hint for easily overcoming this difficulty. He attaches a piece of flexible hose to the tube of a vacuum cleaner, and while the machine is operated he readily extracts every particle of loose carbon. With this apparatus he uses an electric light and a small mirror to enable him to see into every obscure corner, and to insure a perfect job.

American Cars Are Good Cars.—A Motor Transport officer with the British Expeditionary Forces in East Africa has written some of his experiences to *The Autocar* (London), and incidentally pays high tribute to the American car, of which he has used quite a number of different makes. He explains that all the roads in the region where the forces are operating are "bush roads, made by cutting down enough trees to afford a passage." and over these roads the cars referred to were driven 100 miles every day, regardless of weather, both night and day. Speaking of the cars in question he says: "Personally I take off my hat to the American car. It is made of good, honest stuff, and it has a certain elasticity that enables it to stand the appalling road shocks without breakage. . . . None of these cars ever receives regular attention; it is just driven until it is smashed or something breaks that needs repairs at the base. We have no time or facilities for adjustments; moreover, few of the men are capable of making them."

Sticking Valves.—An annoying trouble that not infrequently occurs is the sticking of valves, especially exhaust valves, which run hotter than the inlet valve and are hard to keep in good order. When an exhaust valve sticks, and does not close properly, there is a leakage, and a consequent loss of compression, that manifests itself in baffling symptoms, so that it is difficult to locate the real trouble. Usually it is assumed that the valve requires grinding in; but before this nice operation is attempted it is well to examine the stem of the valve closely to see that the trouble is not there, which is mostly the case. An accumulation of burnt-on carbon will usually be found on the stem, and this must be removed by a file and emery cloth; and it is a good plan to then roll the stem on a piece of a broken emery wheel. The stem is not clean until its original color is restored. The guide must also be well cleaned, and reamed out with a tool of proper size. This treatment will prolong the life of the valve, save much unnecessary grinding and cause the motor to operate better.

Long Hauls by Motor Truck.—The use of the motor truck for hauls that five years ago would never have been thought of in any other connection than with the railroad has come within the past few months to be accepted as a matter of course. Still, we are perhaps not yet quite so sophisticated in the matter that we cannot appreciate the very remarkable showing made recently by five trucks out of Akron, Ohio. These trucks, which constituted part of the recently established Akron-Boston service, were withdrawn from this line and sent from Akron to Chicago with 18 tons of tires for the Chicago trade. Leaving the Windy City with a cargo of Red Cross hospital supplies, they proceeded with these to Baltimore for shipment to France. From Baltimore, after unloading, they ran light to Trenton, N. J., where they picked up 20 tons of wire rope and trucked this load back to Akron, where it was badly needed. For the 440-mile run to Chicago the running time was 35½ hours gross and 22 hours net; the 850 miles from Chicago to Baltimore was negotiated in 100 hours. The trucks were back in Akron, ready to resume their Akron-Boston schedule, within a week after being detached.

Bullet Versus Armor

The Familiar Contest of the Sea Started Anew Upon the Land

By Edward C. Crossman

FROM the day the horrified jackies of our old navy watched their round shot bounce off the armored sides of the "Merrimac," ballistic sharks and armor experts have striven assiduously to produce the fabled condition of an irrestible force meeting an immovable body. The "Merrimac" was efficient not because her armor was anything but crude railroad iron, but simply because this sufficed to stop the inefficient missiles of the day. A tug with a modern 3-inch quick firer could have stood across Hampton Roads and whipped the hind sights off the poor old turtle-back without taking a scratch.

From that hour to this, and with the end not yet in sight, projectile maker has gone armor manufacturer one better, only to have the other "see and raise" him, with the process repeated in wearisome iteration. And now the argument has been transferred to land, becoming the case of the rifle and machine gun *versus* the steel shell for men, cars, planes and tanks.

After every war, authorities and near-authorities emerge with a full list of the conclusions drawn therefrom, which are final and admit no argument. Thus the Boer War did away with the bayonet. The British were very bitter about this weapon. What was the bally use, they asked, of a bloomin' bayonet when the bloody Boers didn't even allow them to get close enough to do fair rifle shootin'? And echo answered, "What"? Our M 1903 rifle had a bayonet installed only after much controversy, and then only because it could also be utilized as a cleaning rod. As a cleaning rod it was fairly efficient, as a bayonet it was a fair cleaning rod. However, before all the bayonets were beaten into pruning hooks and safety razors, the Japanese got into their Manchurian argument with Russia, and the bayonet hastily came back into its own.

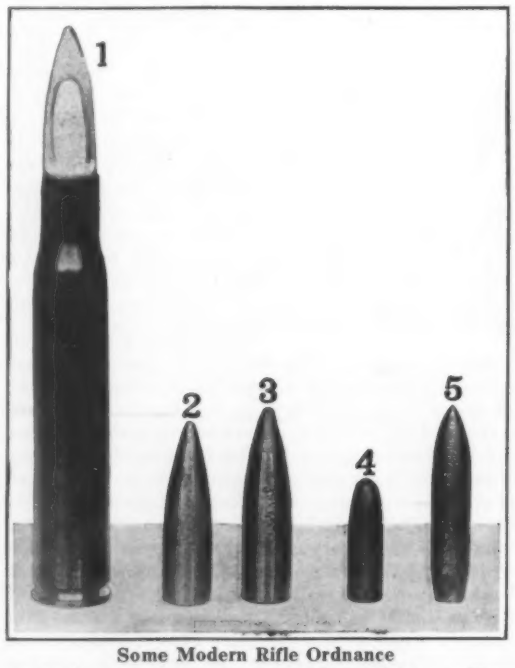
The same optimistic attitude as to the capacities of the magazine rifle that nearly did away with the bayonet was also responsible for the abandonment of any other protection against modern bullets than Mother Earth. The big lead slugs of the 70's and 80's were entirely adequate to driving through the light armor of the cuirassiers; then the excessive penetration of the Krag and the Lee-Enfield, when these appeared, seemed definitely to put the quietus upon the armor side of the question. It is doubtful that even today armor would be revived as it has been, were it not for the many things of lighter penetration than bullets which are flying about our battlefields—shrapnel, shell splinters, grenade fragments, bayonet points. These things made light protection for the head very desirable; this, extended to the body in the form of a light cuirass affair, was then, because of the comparative immobility of the troops, thickened into protection against the bullets themselves, despite the weight thus added.

At the present time, therefore, we find a second coming of armor for man, gasoline horse and flying machine not equalled since the Middle Ages. The armored tank waddles imperturbably astride of machine gun positions and cleans out the operators therein, it saunters down street in the face of cracking infantry fire. Armor coats the engines and most of the crew of airplanes, it surrounds light motor cars, it covers the head of every soldier of the fighting nations outside of Russia. It has been tentatively taken up as body covering in the form of layers of canvas and steel or of woven steel links. In thickness merely enough to stop the plain infantry bullet, it forms the shield and the apron of every field gun. Most of these things, to be sure, are practicable only while the forces are in a state of relative deadlock; their weight would hamper troops on the march. But the fact of relative deadlock remains.

Our armored cars are reported to be covered with treated steel ¼-inch thick, which is sufficient to keep out the ordinary bullet. The photograph shows the slight effect in this case. The armor of the field gun is ½-inch thick, and turns the service bullet at 100 yards, as proved by the two bullet marks on every gun-shield used in our Navy. Our service bullet gets through a scant half inch of mild steel. The special target-shooting pill makes the full half-inch; so does the German bullet. But against specially hardened armor steel any of these bullets might merely shatter, with no penetration worth speaking of. Knowing this, it was an easy matter to evolve armor and plates to keep the service bullet on the right side of the thing shot at.

Steel breastplate worn by German shock troops, specially equipped for assault work

But at this stage of the game the projectile maker took a hand again, and once more the race was started between armor and projectile; and its ultimate outcome is as problematical as ever.



Some Modern Rifle Ordnance

1—Sectional Clay Bullet. 2—U. S. Service Bullet. 3—The Clay Armor-Piercer. 4—Steel Slug from Clay Bullet. 5—Steel Slug from German Piercer.

Special armor piercing bullets were not new when war broke out, but the occasion for them had been limited to getting through the shields of field artillery, and infantry didn't often get close enough to field guns to make this need an urgent one. But after the first year of the war, when snipers began to ensconce themselves behind armor shields and armored cars began to reinforce infantry at threatened points of the line, while airplanes demonstrated surprising immunity to machine gun fire, the ordnance experts began to take a keener interest in bullets that would not be so easily discouraged on meeting a stubborn steel plate.

The writer has had the privilege of testing several hundred rounds of ammunition loaded with the most successful armor piercing bullet yet evolved in this country, designed by Capt. W. L. Clay of our Ordnance Department, and made at Lowell, Mass., under the supervision of Captain Doe, formerly of our army. This bullet, (patent number 1202162), in common with most armor piercing bullets, uses the hardened steel core within a lead and cupro-nickel outer coating. It differs from any other bullet in that it is closed at the rear and filled from the front end of the jacket, giving higher penetration because of the lessened stripping tendency of jacket and lead. Also it has a softer nose than the tough cupro-nickel jacket. This enables it to bite on hardened steel surfaces very much inclined to its path instead of merely glancing off, as does the service bullet with its sharp nose and long shoulder.

This softer cap may be of lead alloy, copper, aluminum, or any other soft metal. In the case of the samples sent me for trial, it was merely soft lead. Inside is a hardened steel bullet in miniature, too hard even to file, and therefore resisting deformation on steel plates. In the samples it was left rather rounding at the forward end, so that enough of the leaden core would be driven forward, forming a cap to support the hard point and prevent it from shattering on the hard armor. In the bullet as finally redesigned, this point was made somewhat sharper.

The slug is .75-inch long and .218 calibre—the difference between this and .308, the diameter of the service bullet, being lead and jacket. The slug weighs 45 grains, the complete bullet 150, matching here the bullet of the service cartridge. Outwardly it is of the same form, but about 1/10-inch longer, to give service weight and of course to compensate for the lower specific gravity of the steel core. It feeds readily through rifle or machine gun. The soft point on the sample makes it look precisely like the various soft point bullets for sporting use of the Springfield.

The accuracy of the Clay bullet, while slightly below that of the service bullet, is higher than that of the regular French model, and ample for war use. At 200 yards it makes groups of about eight inches for ten shots, and at 1,000 yards it develops some ten per cent of fliers, but not enough inaccuracy in the remainder to make its shooting inferior to the regular ammunition from a practical standpoint.

In mild steel, which as stated is no test of comparative effects, the Clay bullet got through an inch—a trifle above 100 per cent more than the service bullet. Lengthening the range and using lighter plates gave an even more favorable comparison. Where falling off in velocity seemed to remove most of the wallop of the service bullet, the Clay armor-piercer continued to get through. At 700 yards against ⅜-inch boiler plate, which the service bullet merely dented, the Clay slug slipped through neatly.

The mild steel developed a peculiarity of the Clay projectile that remains still unexplained. On a piece an inch thick and a trifle tougher than the first sample, slug after slug stuck after getting almost through—pulled up with three quarters of its length projecting from the back side of the plate, gripped by some action that prevented its final egress. In theory at least, when a steel shell goes through a plate with half its length, finishing the penetration is so much a matter of touch and go that a few yards' difference in range might be expected to put it through, or see it not so far in; but the theory didn't work out. Altering the range 50 yards or so altered the phenomenon not a particle. At 750 yards some of the slugs stuck even in the comparatively thin ⅜-inch plate. This stubborn refusal to go clean through seemed to demonstrate either a welding effect, or else a wedging of the steel in one direction by the slug head, and then a closing up on the body before the slug finished penetration. A trial with a cupped point of full diameter of the slug *à la* drill should throw some light on the matter.

Italians, equipped with tank armor, advancing in the teeth of furious machine-gun fire

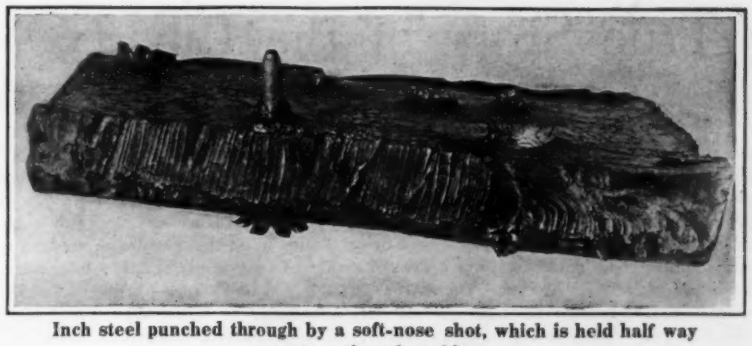
On hardened steel, as near armor specifications as we could obtain, the effect of the piercer bullet was even more marked. At the muzzle it romped through ¼ to ⅜-inch hardened steel, on which the service bullet merely spattered; at 400 yards it got through ¼-inch, though this was possibly not quite up to Government quality. The trials demonstrated that the making of steel for this light armor is in itself a ticklish job. One piece, ¼-inch thick and glass hard, shattered to bits under the bullet's blow. On such steel as this the service bullet does not even offer to go through, merely putting a wide and very shallow dent in the plate; it gives just a blow, without drilling tendency. This is true even on the light ⅜-inch field-gun armor.

I am satisfied that at 500 yards the Clay bullet will get through the present shield and apron of our field gun, and that at 300 yards it would ruin our tanks with their quarter-inch protection. The light shrapnel helmet stops it at long range, and so does the airplane armor; but the bullet will go through the former at 2,000 yards and through the latter at 1,000. The British tanks are very heavily armored, and it is doubtful if even this type of bullet will go through.

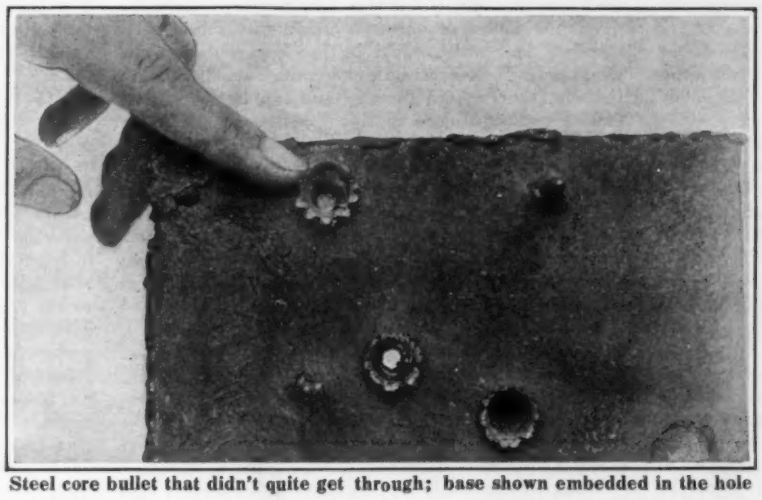
The Germans are not behind us in the development of armor-killing projectiles. Before me lies a German piercer bullet from the Ypres salient, with which a sniper was killed through a quarter-inch of armor steel. This is a whale of a bullet, far too long to feed through the magazine of a rifle or machine gun without some change of parts. It consists of the usual hardened steel slug, leaden wall, and surrounding steel jacket; but the slug alone is as long over all as our complete service bullet, weighing 86 grains against the 45 of the Clay slug. It is very sharp pointed, although the taper is not long; and it is boat-shaped, having a tapering tail of only .20 inch. While it has hit steel, so that the lead core is nearly all missing, the fragments remaining weigh 147 grains, giving a mass around 200 grains for the finished bullet.

This elephantine piece of ammunition is without doubt a terrific drill for armor, probably much more so than the Clay bullet. But it has the serious drawback that it is not at all adapted to work with the regular ordnance and its ballistics will be a thing apart, where the Clay bullet shoots to the sight graduations on our rifle and machine guns. It is apparently used in special rifles for snipers, re-sighted for it, or in special machine guns altered to handle the long cartridge—perhaps in both. Even though the infantry rifle were made to chamber it, it would not shoot to the sight markings, either the vertical ones or the lateral zero.

The one general objection to all these armor piercing bullets is that, after completing penetration, they are reduced to tiny steel shot of .218 to .24 calibre; the remainder of the bullet disappears into thin air on impact with the steel. The wounding power of a steel slug of such size and weighing but 46 grains is less than that of the familiar .22 long rifle, in spite of the advantage in velocity at the short ranges. But in spite of this, these bullets will greatly reduce the enthusiasm for steel bullet stoppers; even a .218 hole in one's anatomy is more discouraging than none at all.



Inch steel punched through by a soft-nose shot, which is held half way out on the other side



Steel core bullet that didn't quite get through; base shown embedded in the hole

The Protective Value of Convoying

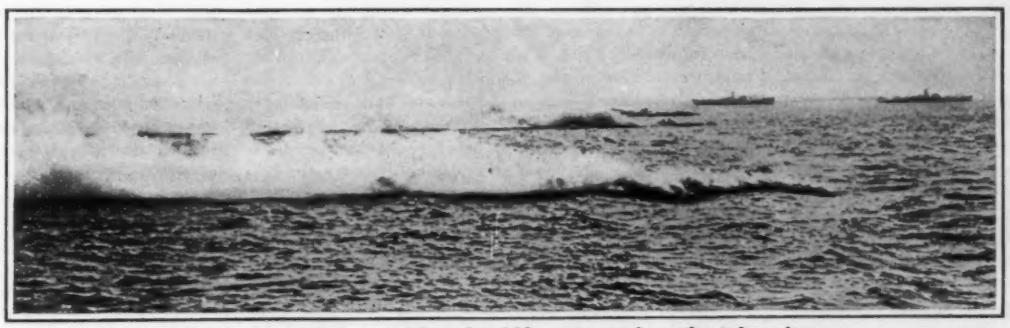
THE gradual breakdown of submarine warfare is not attributable to any one anti-submarine device but to the cumulative effect of many such. If there is a measure that stands out as pre-eminently successful in cutting down losses, it is the introduction, or rather the reintroduction, of the convoy system—for convoying was well known and extensively practiced in the days of Nelson and the sailing frigate.

When it was decided to reintroduce convoying, there was practically no experience to draw upon; for it was evident, at once, that dispositions of ships in a convoy which were effective in the days of sail power might be altogether unsuited to this age of steam power. Various formations were tried, and the present effective practice was ultimately developed.

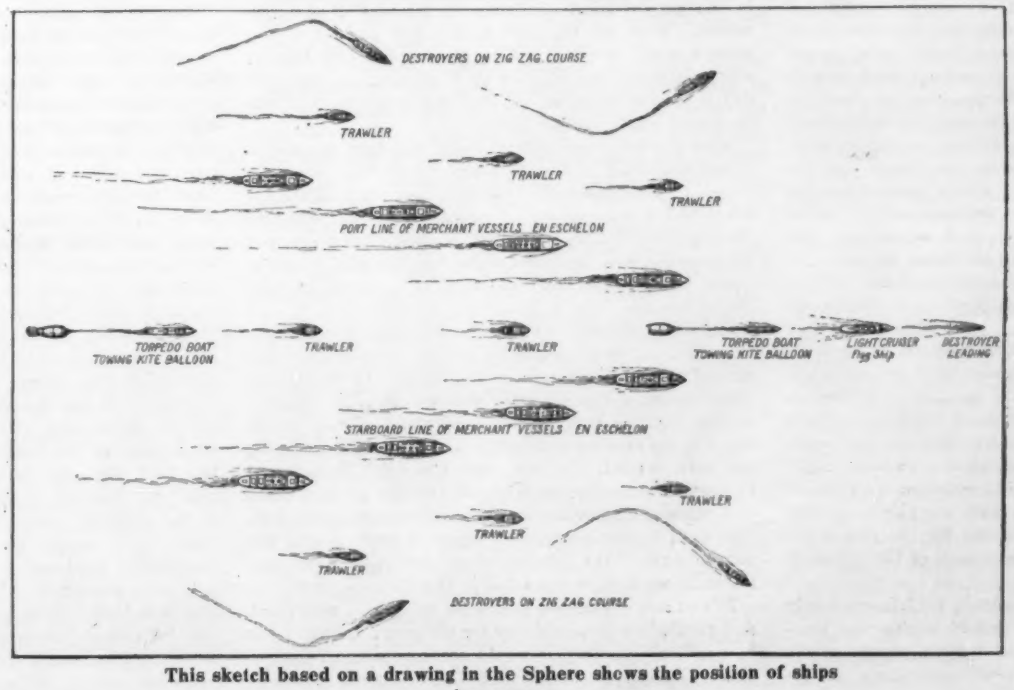
On the colored cover of this issue and in the accompanying diagram, is shown the wedge or V-shaped formation, in which the convoyed merchantships steam in two echeloned lines. The disposition, both of the war and merchant vessels, is, at first sight, rather complicated; but actually is not so. It is most admirably adapted for getting an early sight of a submarine and putting it out of commission, or driving it away from the path of the convoy.

At the head of the convoy is a destroyer; following this is a light cruiser which acts as a flagship. This, in the case of our own Navy, is frequently an armored cruiser of the former "Colorado" or the "Tennessee" type. Then, astern of the cruiser is a torpedo boat which tows at the end of a light, but very strong steel wire, a captive balloon. This craft forms the point of the "V" formation; and behind it are placed the two diverging lines of merchantships which follow each other, not bow to stern but disposed diagonally. At the stern of each ship is towed a spar or buoy which serves to tell each succeeding ship how far it is astern of the ship ahead—an absolutely necessary precaution at night or in thick weather. Down through the center of the "V" is a line of armed trawlers; and another line steams on the outer side of each column of merchant ships. Slightly astern of the convoy and at about the center of the base of the "V" is a destroyer or torpedo boat which tows another observation balloon. Finally, to complete the protection, several destroyers steam in a zig-zag course well out on each wing of the convoy.

The efficiency of the system was recently alluded to by Sir Eric Geddes in the House of Commons. He stated that one result of the convoy system has been to drive the enemy closer to the shore, thus rendering the open sea safer for navigation. During the first months of the unrestricted submarine war 50 per cent of the losses (of merchantships) occurred more than fifty mines from land, and only 21 per cent within 10 miles of the shore. Today the losses outside the 50-mile limit have fallen to one per cent, while the losses close to land have risen to 61 per cent. This transfer of attacks nearer the coast gives increasing opportunities for attacking the enemy by patrolling surface craft and airplanes, and enables us to save many vessels which otherwise would have been lost.



Smoke boxes thrown overboard to hide a convoy from the submarines



This sketch based on a drawing in the Sphere shows the position of ships in a convoy

New Danish Heat-Insulating Material

THE *Board of Trade Journal* quotes the Danish press to the effect that a new company, with a paid-up share capital of 500,000 crowns ($134,000 at normal exchange) has been formed to manufacture *molersten* (heath clay stone), a material which can be used for insulation.

Several attempts had previously been made by the State Testing Department to utilize the loam obtained from heath clay beds on the island of Mors, in the Lym-Fjord, for the manufacture of insulation materials for use in air flues, steam boilers, etc. The experiments were continued with good results by a Norwegian engineer, and he has now succeeded in producing a *molersten* which is made porous by undergoing special treatment. The clay is mixed with what is termed expanded cork, *i. e.*, cork dust which, before being mixed with the clay, has been heated. By first undergoing the heating process the cork occupies a larger space in the clay mass than otherwise would be the case. The cork is kneaded into the clay, and the whole mass is then molded and subjected to heat. By this means the *molersten* is made highly porous and is found to be much better adapted for insulation purposes in ordinary practice than any other kind of stone.

Large clay beds on Mors have already been acquired, so that the manufacture of *molersten* can commence as soon as the factory which is being constructed is completed.

The True Story of the Liberty Motor

The Lightest and Most Powerful Airplane Engine Produced on a Quantity Basis

WHEN Secretary Baker made the dramatic announcement last summer that a new motor, christened the "Liberty" had been developed by two American engineers in a five-day conference behind locked doors, men who were experienced in machine design shrugged their shoulders. They knew the impossibility of designing so highly refined a machine as an airplane motor in such a brief time. They assumed, therefore, that the so-called new motor was probably a standard motor in which a few modifications had been introduced; and speculation was rife as to what particular standard motor had been adopted. It was at first claimed that the German motor, known as the Mercedes, formed the basis for the Liberty Motor; then other claimants came forward.

An air of mystery has surrounded the Liberty Motor from its inception, and it is high time that this was dispelled. Recent announcements from the War Department, disclosing details of the motor and their similarity to other motors of American and foreign design, give us the liberty to tell here for the first time the real story of the development of our standard aviation motor.

Shortly after the outbreak of the great European War, Mr. Henry Joy, then president of the Packard Motor Car Company, became impressed with the importance of the airplane in modern warfare. He felt certain that before the conflict was over the United States would be involved; and looking about among our motor manufacturers he realized how poorly prepared we were to produce the motive power for aerial warfare. There was no question that Europe was far ahead of us in the construction of airplanes and airplane motors, and being a motor manufacturer himself he realized how long it would take to develop the manufacture of first-class motors in this country, even after we woke up to the realization of their necessity. Therefore, he urged his company to proceed at once with the development of an airplane motor which would compare favorably with the very best produced in Europe. This was in the fall of 1914.

In the spring of 1915, work was started on such a motor, and the design was completed in November of that year. The engine was ready for block test in February of 1916. As there were no facilities for testing airplane engines by actual flights in this country, the new motor was placed in a racing chassis of special construction and was subjected to severe tests at the Sheepshead Bay Speedway. The engine was of 299 cubic inches displacement, or just under the 300-inch racing limit established by the A. A. A. It was of the 12-cylinder "V" type, with cast iron cylinders. After it had been thoroughly tested out, a second model was designed, based on the principles that had been proved out on the first model. This was of much larger design with four by six cylinders and of 905 cubic-inch piston displacement. The new motor was provided with an airplane propeller and mounted on a truck. With this unique power plant the truck was driven about the streets of Detroit. The air-propelled truck could travel faster than any man would care to drive it. In one test, the wheels were locked and yet the truck was pushed over snow-covered ground.

In April, 1917, a second engine of this model was completed and placed in a racing chassis. It established the official world record of 130 miles per hour—or a mile in 28.76 seconds. In this second model, steel forged cylinders were used, fitted with pressed steel jackets welded on. Considerable difficulty was at first experienced in attempting to weld the jacket to the cylinder without burning the metal, or introducing strains in it. After a considerable experiment it was found that the meeting edges which were to be welded, must be of the same thickness, otherwise the heavier section would carry off the greater proportion of heat and the two surfaces could not be heated to the same temperature. By reducing the surfaces to exactly the same section, welding with the oxy-acetylene torch was readily accomplished.

In the first model, the cylinders were set at an angle of 60 degrees, following the practice used in automobile engines; but in the second model an angle of 40 degrees was adopted so as to cut down head resistance. Tests of the engine showed that there was no noticeable vibration with the cylinders set at this unusual angle, even when the engine was run at considerably reduced speed. In this engine, the cam shaft was placed directly over the cylinders and the housing for the cam shaft acted as a truss to hold the upper ends of the cylinders rigid.

The third model was begun in April, 1917, immediately after war was declared, and the first engine was completed in May. This contained certain improvements over the previous models, aimed particularly at reduction of weight and simplification of manufacture.

One of the first demands upon this country when it entered the war, was to start the manufacture of airplanes in large quantities. We had a reputation for manufacturing on a quantity basis, and it was felt that if we turned our great industrial organizing ability upon this problem we could turn out a fleet of airplanes that would simply overwhelm the enemy. Our engineers had studied the foreign airplane motors and a number of them were being made in this country. It was realized, however, that they were not adapted for quantity production on an American basis, and it was very necessary for us to develop a motor of our own which would become a standard and which could be produced in enormous quantities. As soon as the United States was drawn into the war, the Packard Motor Car Company offered its models and experience to the Government and being actuated by patriotic motives was perfectly willing to abandon, for the time being, all claim to the origination of this motor, although it had expended $400,000 in its development. However, there were some changes that the Government called for and it was felt that a representative of some other motor manufacturing concern should be called in to advise with the Packard engineers in the modifications which would eventually be adopted by the Government. Accordingly, Major Hall of the Hall-Scott Motor Company was called to Washington to confer with Mr. (now Lieutenant-Colonel) Vincent, chief engineer of the Packard Company. Mr. Vincent had with him the blue prints of the complete plans of his motor and these were studied by Major Hall who suggested a number of changes.

When the war first broke out, airplanes were fitted with 100 horse-power engines. Very soon they were found to be insufficient and engines of 125 horse-power were made. The engine power then gradually increased to 150, 175, 200, 250; and it was about in that neighborhood when Major Hall and Mr. Vincent were called upon to furnish the United States standard motor. It was felt that a motor should be designed so far ahead in power of anything else that had been produced that, by the time it could be turned out in quantity, it would still be well in the lead. Accordingly, a horse-power of between 350 and 400 was sought and the size of the cylinders was changed from 4 x 6 to 5 x 7. Because of the larger cylinders required in the new motor, the angle of the V was changed from 40 to 45 degrees. The larger pistons and cylinders required slightly greater clearances. In place of the forced lubrication of the crank shaft which was provided in the Packard engine the scupper system was introduced by Major Hall, because it had been found very efficient on the Hall-Scott motor. This is also a feature of the Mercedes motor. The scupper consists of a small cup-like flange on the crank arm which catches the oil and throws it up on the bearing of the crank shaft. These and other slight modifications were thoroughly discussed and decided upon by the two motor experts who worked unceasingly and arrived at the finished design in a conference lasting five days. They had a herculean task before them and deserve the highest praise for the successful outcome of their efforts.

As soon as the conference was over, telegraphic instructions were sent on to the Packard plant and work was started immediately upon the new motor. Even before blue prints arrived the wood model was prepared in the general form and essential features of the new motor. Work on the new engine was pushed at the highest speed possible, and on the third day of July, it was completed and shipped to Washington. The next day it arrived there, on the Nation's birthday, and was christened the "Liberty Motor."

After the first experimental motor had been completed it was subjected to a great many trying tests, and was found to be exceedingly efficient and very light. It developed a horse-power of considerably over 400 and its weight was but little over 800 pounds. Its weight per horse-power was therefore about two pounds, which is much lighter than the majority of airplane motors. On endurance tests it stood up wonderfully. It was tested at the summit of Pike's Peak in order to determine its action under conditions of rarified atmosphere—and proved very satisfactory. At the Bureau of Standards in Washington, a special room was set aside in which a partial vacuum was created equivalent to that which exists at the maximum height to which an airplane engine has been carried. In this room the engine was found to operate perfectly. At one of its first altitude tests in a plane the American record for altitude was smashed. Not until September was the order to proceed with the manufacture of the Liberty Motor definitely given, and immediately work was started in the Packard plant.

It was not considered advisable to build a new plant and purchase new machinery for the manufacture of the new motor because this would consume a great deal of time. Instead, it was decided to give up the manufacture of automobile motors for the time being, and rearrange the machine tools to take the new motor. While the plans were being prepared to carry this out the automobile motor plant was operated day and night at full capacity in order to produce as many automobile motors as possible before the manufacture of them stopped. Under this intensive program, by the end of the year, a large stock of motors had been machined and for the most part assembled to meet the commercial demands. In the meantime, work on the new Liberty Motor was going ahead as fast as possible. New jigs had to be constructed, machine tools had to be fitted with new appliances, and the work had to be organized so that the motor could be produced on a large scale.

It is interesting to note that the first experimental motor was delivered to the Government on the 4th day of July, and the first production motor was sent to Washington on Thanksgiving Day. This, however, did not mean that the production problems had all been solved. No one except a man who has actually had experience with such work can realize the infinite amount of detail required in organizing a new industry. Usually, the organization work does not make any showing at all to the general public, and consequently is not appreciated. One of the engineers of the Ford plant told the writer personally that he thought every one would recognize the right of the Ford Company to an opinion on quantity production manufacture. He said that never in the world's history had a greater piece of work been done on a similar scale. The development of the Liberty Motor was simply short of marvelous, and the public instead of criticizing the manufacturers for slowness should be thankful that they have had such competent men to carry on the work and develop a motor of such efficiency in so incredibly short a space of time.

The motor which was delivered to the Government on Thanksgiving Day developed a number of small troubles. One of these was the difficulty of lubrication, and eventually it was found necessary to change the scupper system to the original forced lubrication system. But the most important change was made in the production of the cylinders. In the first Liberty Motor, the cylinders had to be bored from the solid—an operation that was very costly in time and money. This, however, was a copy of the best foreign engineering practice, and was followed as a necessary detail by our engineers. It was at this juncture that the engineers of the Ford Motor Car Company made a notable contribution. They developed a cylinder forged out of steel tubing, which enabled the manufacturers to turn out the cylinders at very low cost and in exceedingly large quantities. Seamless steel tubing is used, and this in but four operations under the forge press and bulldozer, is converted into a headed and flanged cylinder blank on which a minimum of machining need be done. The manufacture of these cylinders was not undertaken until the end of January and now they are being turned out in very large quantity. Each week, the cost of producing the cylinders has been reduced slightly, and all the savings made have been turned over to the Government. At the time the writer observed the work on these cylinders, the cost had been cut down more than half, with even greater economies in prospect.

One of the difficulties encountered in the Liberty Motor had to do with the form of ignition. In the original Packard motor, the "Delco" system of ignition was used. This consists in generating current with a small electric generator geared to the engine shaft and then transmitting the current by means of a pair of distributors to the spark plugs. Magneto ignition was tried, but it proved impossible to design a single magneto which would operate with the irregular timing required in an engine in which the cylinders were set at the unusual angle of 45 degrees. A single magneto could not be used and so a battery of four magnetoes had to be employed. This added somewhat to the weight of the engine. Then further difficulties were encountered. Owing possibly to the vibration of the engine at high speed, the magnets of the magneto showed fatigue and gradually lost their magnetic property. So that eventually it was decided to return again to the original system of ignition. One of the marked differences in appearance of the Liberty and Packard "900" is due to the fact that the latter is provided with reduction gearing. The advantage of this is that it places the hub of the propeller more nearly in line with the center of area of the engine, so that far more efficient driving results are produced in the air. For this reason the reduction gearing is being looked upon with favor now, and it is highly probable that there will be a return to this feature of the original Packard "900." Furthermore the ideal speed for the engine is higher than ideal propeller speed. It is rather remarkable that in a

(Concluded on page 515)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Where To Get Lime Water

To the Editor of the SCIENTIFIC AMERICAN:

In an issue of your paper a few weeks ago I noticed the article on how to prevent the souring of whole wheat bread by the use of lime water. I have a little hand mill with which I grind the wheat and to this 100 per cent flour, some boiled potato is added. The flour is mixed with warm lime water, slightly more yeast is needed than for the usual white flour and more time is allowed for the raising. The resulting bread is most satisfactory.

In your last issue a correspondent spoke of buying the lime water at the drug store. The simplest way of getting the lime water and the one which I have used is as follows: Empty a bottle of Lily's Lime into a gallon of water. This is thoroughly stirred and after about an hour and a half is fit for use. This lime water may be kept for an indefinite period by pouring, when thoroughly stirred, into glass jars which have tops that can be screwed on tightly. I get these little vials of lime in packages of one dozen.

H. E. HALE, M.D.

New York, N. Y.

"Spurlos Versenkt"

To the Editor of the SCIENTIFIC AMERICAN:

I have frequently read of "sinkings without trace" during the present war. Just now we are anxious about the "Cyclops."

To avoid this I suggest that all vessels be provided with a considerable number, say 100 or more, bottles that can be quickly sealed with messages indicating name of vessel, location, and some information as to the disaster that overtook it. Each of these bottles to have attached to its side a block of slowly soluble substance, that is slowly soluble by salt water, and be so made as to float for several hours a number of feet below the surface. When the substance is dissolved, say in a day or so, the bottles will arise to the surface—and there being many, in the course of time some of them will be discovered.

D. F. MAHER.

Watsonville, Cal.

Water Power for the Automobile

To the Editor of the SCIENTIFIC AMERICAN:

A world which depends more and more on the gasoline engine is within sight of the end of its supply of gasoline.

A world which depends more and more on steam is within sight of the end of its coal.

The one way out is, of course, water power.

Distribution of that power with the least loss is the problem; to auto drivers it is not yet solved.

However, we have the seed of what I believe will grow to the power "plant" to solve the problem. We now have in the experimental stage motors run by wireless waves. There is nothing in the way of a practical and universal application of this principle to motor traffic.

The war will cease—but the airplane will remain with us, strong, safe and comparatively cheap. I expect to live to see the time when travel, instead of being dependent on surface roads, will be largely through the air, and when the engine that propels the plane will be an electric motor, run by wireless power.

Great power plants will be stationed at the source of the power; costs will be paid by licenses imposed on all air travel. All the plane driver will do is to wheel his machine out of the hangar, switch into connection with the waves for which his motor is tuned, and go—without carrying fuel, without engine trouble, and without stop unless he so elect.

CHAS. LOWATER.

Spring Valley, Wis.

Trap Shooting in Our Army

To the Editor of the SCIENTIFIC AMERICAN:

Being under the impression that perhaps a few remarks would not be out of place from one who has had a varied and wide experience in shooting afield and at the trap, I venture to address your readers, hoping to claim their attention for a few moments, and perchance contribute some information on an important subject concerning trap-shooting with the shotgun as practiced today in our Army.

For the benefit of those who do not understand the game, the present system in vogue among trap shooters is to place five men in a row facing a magazine *stationary* trap, from which discs are propelled through the air at a distance varying from forty to sixty yards, said disks or targets being released at the word "Pull," given by the shooter when he has *poised* himself, placed his gun to his *shoulder*, alined it and feels ready to shoot the instant he covers the target.

Regarded purely as a game, the main object being to train its devotees to make long runs and reach high scores, it is very doubtful if any radical improvement can be inaugurated I believe that there is no finer outdoor game played; it appeals to both old and young, men and women; it teaches the proper use of the shotgun so far as handling it is concerned; and it inculcates lessons in the care with which it is used regarding safety to oneself and to others.

Yet the very open question arises in my mind whether our soldiers, when trained for actual man-killing service, are getting the pith of the shotgun efficiency when taught to handle those weapons and shoot them, under what must appear to any casual observer to be conditions very far removed from what will obtain when fighting man to man. Nothing could be more grotesque than to imagine a lot of men advancing toward an invisible foe with their guns plastered to their shoulders, in a fixed and strained position alike useless when hunting man or game afield.

To overcome all such fashion-plate actions, I submit that we should train our men to stand in an easy position, gun carried in any way so it can be promptly mounted to the shoulder and fired. Where practicable the men should move about. Instead of releasing the targets from any kind of stationary trap, let hand-traps be used by men proficient in throwing targets in all directions, at all angles, at any time, and whose business it is to baffle the shooter, and give him just as hard shots as possible.

The hand-trap is a light portable contrivance, very easily manipulated, not apt to get out of order or break down under service conditions, and as compared with a ponderous stationary trap, a far more useful machine, which could easily be carried from place to place wherever the flying targets are transported and used. From every standpoint it is a practical thing that under proper management will certainly make better all around shots

Huge mine field closing the North Sea

of those who use it, and in no way conflict with the regular style of trap shooting from the large stationary traps that are being used today at our Army posts and cantonments.

The free, fast and accurate use of the shotgun is its *raison d'être*, for its range is short. But within its limitations it is a most formidable and deadly weapon and, when used under certain conditions at close quarters, would cause great havoc if properly handled. The hand trap if maniuplated by any one trying to make it do its best will afford the very best kind of practice for our troops whether on land, sea or air.

The difference between shooting at flying targets thrown from a stationary trap, under existing rules, as against shooting at them when thrown in a rough and tumble way from a hand trap, is about on a par with rifle shooting at a stationary target of known size and distance, as compared to skirmish firing where everything is unknown and where the soldier depends on accuracy and speed to accomplish the desired result.

It stands to reason that the man who has been taught to handle the shotgun as it was intended it should be used, *i. e.*, swung to the shoulder and instantly fired, regardless of the position in which he may find himself, or of the object he intends to hit, is perforce a far more dangerous antagonist than the one who has to assume a stereotyped attitude, and who is handicapped still further through being accustomed to shoot at objects going at a regular speed in a practically known course.

"GAUCHO."

Block Floors

To the Editor of the SCIENTIFIC AMERICAN:

The article on page 357 of your issue of April 20th "Floors made of wood blocks" is very interesting, and is approximately correct, the only questionable points being the statement that certain short leaf pine in Missouri and some parts of Arkansas is being largely substituted for long leaf, and that its lack of strength causes it to break up under loads in floor service.

I think the writer of the article evidently had in mind an inferior quality of yellow pine, but having referred to the very close-grain clear stock found in southern Missouri and some parts of Arkansas, he is doing that species an injustice, as it is I think recognized the equal of close-grain long-leaf. It comes under the density rule recognized by the American Railway Engineering Association, which has at last adopted that rule, doing away with the old distinction of long-leaf as against short-leaf yellow pine, which meant nothing, there being as much inferior long-leaf as there is short-leaf, and I might say, quite as inferior too.

The article would imply that creosote treatment is necessary for all block floors, while as a matter of fact, it is not only unnecessary for many interior floors, but is very objectionable, particularly where foodstuffs are handled. Creosoted blocks can not be used in freight houses. There is a composite block floor made which your paper was good enough to notice some two years ago, when it was first brought out. It has all of the good qualities of block floors, and in addition it lays smooth and stays smooth; costs no more than creosoted blocks, and is free from the objection of creosote for inside use. Its wearing qualities are the same, but being untreated it is not recommended for outdoor use, or to be laid in very damp places.

I call your attention to this apparent improvement for certain uses over the loose blocks, whether treated or untreated, with the idea that you will desire to make further mention of it in comment upon your recent article.

C. J. CARTER.

Kansas City, Mo.

The British Close the North Sea

THE British Admiralty has recently made an announcement of the establishment of a "prohibited area in the North Sea which is dangerous to all shipping." The boundaries of this area are announced in the customary nautical phraseology as starting at such a latitude and longitude, extending to another latitude and longitude, and so on, until the starting point is reached.

To the ordinary citizen this would convey no very definite information; but if he were to take a map and plot out the boundaries of this area, as thus defined, he would find that it forms a huge triangle whose longer sides are six hundred and fifty miles in length and whose base, measured on a straight line from east to west, is nearly four hundred miles. He would find, moreover, that within this triangle is contained an area of approximately one hundred and twenty-two thousand square miles.

Now, although the British Government does not state why this area is prohibited, it is possible to make a pretty good guess that it is sown with mines. How many mines it has taken to cover this vast area we are not told, but if there were only one mine to the square mile we would have one hundred and twenty-two thousand, and if there were ten to the square mile, there would be about a million-and-a-quarter within the area. The mines may be sown more closely; but if there were but one to the mile, a submarine, in moving across the four hundred miles at the base, would run more or less risk of striking four hundred mines.

At first sight, one is surprised at the shape of the mine field, and asks why it has been carried so far up to the north. The answer is to be found in the fact that while the mine field has been laid right up to the Scottish coast, on the Norwegian side it terminates three miles from the coast, stopping short at the edge of the three-mile belt of neutral water. The Germans, who do not hesitate to break all laws of God and man, will not respect for a moment the neutrality of Norway, and their submarines will steal out on the edge of the mine field and so get out into the Arctic Ocean. Having done that, they will find themselves obliged to proceed north for over six hundred miles before they can turn south and make for their favorite hunting grounds at the entrance to the Irish Sea and the Channel. Consequently, they will have to make a detour of some thirteen hundred miles. Returning, the submarines will have to make the same detour.

Now, mark the significance of this. Unless they are willing to risk the peril of traveling several hundred miles across the mine-infested area, each submarine must cover twenty-five hundred miles more distance during a round trip from Kiel to the submarine zone and back, than it did before this mine field was laid.

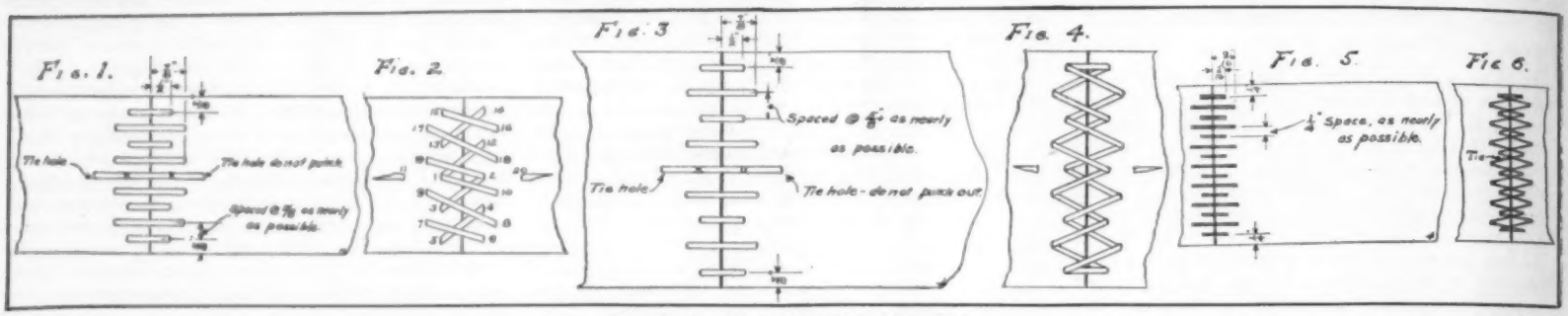
The announcement by the Admiralty of the completion of this stupendous work coincides in time with the two raids which were recently carried out against the submarine bases at Zeebrugge and Ostend. It shows that the strong offensive against the enemy bases, for which the Navy has been preparing throughout the year, is now in full swing. Admiral Jellicoe announced in a public address not many weeks ago, that, by the late summer, the public might expect to see the activities of the German submarines very materially curtailed.

Now that the North Sea has been blocked in, we may reasonably look for a considerable reduction in the losses of merchantships.

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University



Approved methods of splicing belt ends

Figs. 1 and 2—Pulley side and reverse side, respectively, of 4-inch single-cross lace. Figs. 3 and 4—Pulley side and reverse of 6-inch double-cross lace. Figs. 5 and 6—Pulley side and reverse of 4-inch double-cross wire lace

Care and Repair of Belts

By G. W. McCuen

IT will be remembered from reading the issue of May 4th, that a simple formula for calculating the proper width of belt to transmit a load safely and efficiently, was explained. Having obtained the proper width of belting, the next step is to know how properly to care for and repair a belt.

The three kinds of belting which are used extensively about farm machinery, are leather, rubber, and gandy.

All belting should be kept clean. The cleaning should be done at regular intervals, and not spasmodically. When dirt is allowed to accumulate it tends to absorb the oil of a leather belt and thus the belting becomes hard and slips on the pulley. Dirt, if allowed to accumulate, should be removed by scraping. Leather belts should not be used where there is any moisture or dampness, such as in a dairy room, as the life of the belting will be shortened. Rubber or gandy are better adapted for such conditions.

Leather belting gradually loses the oil which has been worked into it to produce flexibility and should therefore be given an application of oil once a week to preserve the flexibility. Castor oil, neat's-foot oil or boiled linseed oil, are good dressings and should be applied to the outside of the belt and worked thoroughly into it by running it under a light load. Resin or mineral oils should never be used.

Leather belting should be run with the hair, or smooth side, next to the pulley; rubber belting with the lap side outside, and gandy either side next to the pulley.

Belting should be examined quite frequently to see that all joints are tight and that the edges are not being chaffed by the flanges on a pulley or a shifting fork. This is especially true of a rubber belt.

There are several methods used to splice belt ends, but the two most common kinds of laces are the whang and wire.

Single-Cross Whang Lace.—The ends of the belt should be squared with the edges and cut off clean and square. The holes are arranged in two rows, the row next to the end of the belt having one more hole than in the second row. Fig. 1 shows the measurements considered most practical for a single-cross lace for all widths of belts.

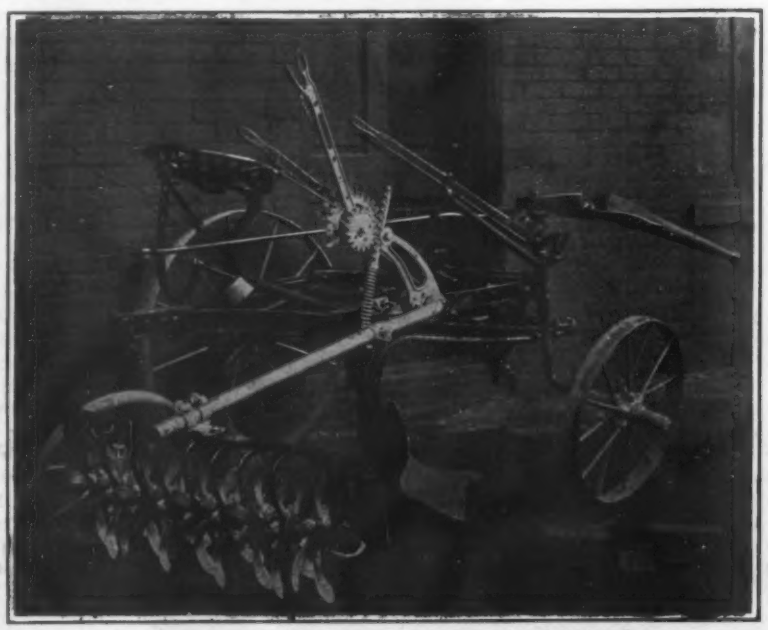
The belt is laced by starting at holes 1 and 2 (see Fig. 2) and drawing both ends through leaving the end to be used last slightly longer. Lace out to the edge of the belt, using the first row of holes and then back using the second row. To finish that side, put lace down through hole 1 and up through 11, which is not punched out, but is an opening made in the belt with a knife or awl. Next take the free end of whang at hole 1 to hole 12 and lace out and back to 19, then down through hole 2 and up through hole 20, which is similar to hole 15, not punched. Fig. 1 shows the pulley side of the belt.

The Double-Cross Lace.—This type of lace is most commonly used for rubber and canvas belts and is strongly recommended by the manufacturers. The same number of lacing strands are used in this type as are used in the single-cross, but two strands are put through each hole and hence the holes are spaced twice as far apart across the belt. This lace is quickly made and is a serviceable type for rough uses, and has the advantage of not weakening a canvas or rubber belt so much as the single cross-lace would. It is bulky and is likely to cause vibration when passing around a pulley. The belt is laced by starting at the center holes and lacing through each hole to the edges of the belt and through the end holes twice, so as to have two strands of whang at the edge, then back through every hole to the center, where it is tied as in the single-cross lace. Fig. 3 shows the spacing of the holes for a 6-inch belt, pulley side, and Fig. 4 the reverse side.

Wire lacing is quite commonly used for leather belts and makes a very nice, smooth joint, which is quite essential for a belt running at a high rate of speed. It is double-cross lace with the ends twisted together on the reverse side instead of being put through a tie hole. Fig. 5 shows the pulley side and spacing of holes for a wire lace and Fig. 6, the reverse side for a 4-inch leather belt. The wire used is a special soft belt wire. Care should be taken not to nick the wire by the use of pliers nor to allow the wire to cross on the pulley side.

It need hardly be pointed out that the styles of lacing here shown are approved because they are the best. The farmer who is a careful mechanic will realize that a belt lacing must be strong and tight so as not to break or pull out, and that it must be smooth and level.

Flexibility of the modern farm tractor



Rotary harrow which pulverizes and levels behind the plow

Leveling and Pulverizing as Furrow is Turned

By P. B. Potter

IN every operation on the farm there is the desire and the necessity for saving time. Wherever two operations can be done at the same time then time is saved and perhaps the planting of the crop is made certain by that speeding up. There has recently come into the market, an attachment for the plow, which makes it possible to do the leveling and pulverizing of the furrow at the same time that the furrow is being turned. In the ordinary cycle of seed-bed preparation the processes of disking and harrowing the plowed field are often delayed until the work becomes quite difficult. Clods form which are hard to pulverize and also much moisture may be lost from the unleveled field. These operations are more easily and efficiently accomplished when done right after plowing, provided, of course, that the plowing was done under correct conditions.

This attachment which follows the plow is called a rotary harrow. It consists of a single gang of closely spaced spading disks. Each disk is made up of a number of sharp, steel blades, which are narrow and have a curved and twisted shape. As the disks roll along, the action of the blades is to stab and slice the furrow to pieces, and as there is a considerable number of these blades, the surface is left with a fine, even mulch. There is a lever for regulating the depth and also a spring for adding pressure to the blades. Since the disks have a revolving action rather than a dragging one, and since they are working on the soil when it is in the best condition, there is only a small increase in draft on the plow considering the work that is being accomplished. The addition of this harrow will add from 7 to 10 per cent to the work of the team. It is made to clamp tightly to the frame of the plow, is readily adjustable in any direction, and can be purchased for the single-bottom sulky or the multiple-bottom engine gangs. It costs slightly more than a single section spiketooth harrow. The accompanying illustration gives an idea of what it is like.

The Adaptability of the Modern Farm Tractor

THE accompanying photograph serves to illustrate one of the numerous obstacles which the modern farm tractor is capable of surmounting without especial harm to its mechanism. The railway locomotive, the trolley car and even the automobile have roadways of fairly uniform condition over which to propel themselves and draw their loads. Not so, the farm tractor, its roadbed is as variable as the topography of the fields in which it works or as the seasons through which it must without essential variation perform its duties. That it performs its task well when capably handled testifies to the progress which is being made in its development.

How One Plant Injures Another

An interesting article published by S. Pickering in the Annals of Botany records the fact that washings from growing plants of many species, such as apple, mustard, tobacco, tomato, various species of grass, etc., have been found to be deleterious to other plants, including apple, pear, plum, cherry, various forest trees, mustard, tobacco, barley, clover and some grasses. Reduction in growth following treatment with such washings varies from six to ninety-seven per cent. The toxic properties of the leachings may be removed by exposure to the air for 24 hours.

A Tale of a Trailer

By R. B. Alexander

THIS is the story of a persistent sales agent and the mechanical evolution of an apparently simple device. Only an experienced manufacturer has any idea of the thousand-and-one difficulties that crop up when attempting to adapt a machine to a new service. It is because the public does not realize these bothersome details and the delays they occasion, that so much impatience is voiced about the time consumed in developing our war machinery.

However, this story has nothing to do with the war, but pertains to so humble a mechanism as a two-wheeled trailer adapted to be hitched to the rear of a motor truck.

About a year ago, a certain company in one of our middle western states, whose name I dare not give lest I be accused of trying to introduce advertising matter into the reading columns of the SCIENTIFIC AMERICAN, received a long distance telephone call from a distributor in Kansas City. He wanted a quotation on ten trailers suitable for hauling oil casing in the oil fields of Oklahoma. He demanded immediate prices, and he needed immediate delivery. Now, the manufacturers of these trailers realized that this was a new service, and probably involved unforeseen difficulties. They had not sufficient information and were loath to construct a trailer which might not anwer the purpose for which it was intended. They had had experience with such requests before, and had learned that the manufacture of a special trailer was not a thing that could be launched upon without considerable study. Accordingly, the telephone request was immediately and flatly turned down.

But the Kansas City distributor was not a man to be refused. When the president of the company reached his office on the following morning he found the man waiting to talk to him. He insisted that he must have at once 50 pipe trailers because the need was very pressing in the oil fields and the opportunity for a large business exceptional. Unfortunately, he had a very hazy idea as to the nature of trailers required, and could merely state that they were to be used behind 1½- to 3-ton trucks, and should be capable of carrying a load of from three to six tons. He did not know the exact length of pipe, the size of the load, the number of pipe lengths that had to be carried, or how these pipes were loaded and unloaded. But he was so insistent that the chief engineer of the company set out immediately for Oklahoma to study the requirements on the ground.

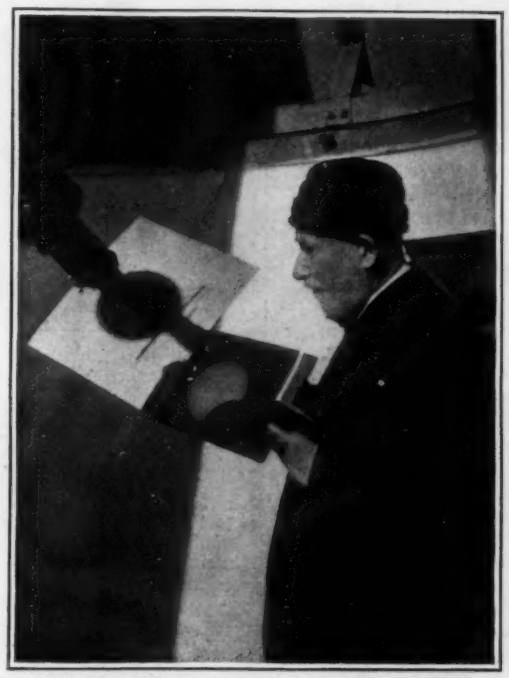
To any one not conversant with the technicalities of trailer design it would seem very simple to construct a two-wheeled affair which could be hauled behind a motor truck. It partakes of none of the complications inherent in a four-wheeled trailer. But the chief engineer, after a careful study worked out a special design, and ten trailers were manufactured for use on the oil fields. They were very solidly constructed because of the difficult ground over which they had to travel and because oil casing is a heavy material. But it was assumed that the pipe resting partly on the trailer and partly on the after end of the truck, would readily adjust itself to variations in road conditions, so that there would be no difficulty in going over uneven ground or in making fairly sharp turns. This, however, proved to be a mistake. Because of their great weight, the casings presented so much friction on their supports that they "froze" fast to them and made a rigid connection between truck and trailer which tended to tear the trailer to pieces. The necessary flexibility was then obtained by mounting swivel bolsters directly over the axle of the trailer and the rear axle of the truck. This made it possible to turn a corner without imposing any severe wrenching strains on the trailer.

But another unforeseen difficulty arose. In the oil fields there are practically no roads, and the casings had to be carried through gulleys and over hillocks. In other words, there are vertical corners to be turned, as well as lateral ones. As the bolsters hold the load considerably above the axle, and hence considerably above the drawbar attachment of the trailer to the truck, either the load had to slide on its bolsters or else the drawbar had to give. Because of the weight of the casings they refused to slide on the bolsters and the drawbar connection being rigid, the necessary give was obtained only at the expense of racking the trailer structure. Something had to be done to make the trailer flexible in the vertical direction as well. The problem was eventually solved by introducing a spring connection in the drawbar, as shown in the accompanying photograph; so that now, on going over uneven ground, the load may hold fast rigidly to the bolsters, while the requisite give is to be found in the drawbar. The extent of motion was also reduced by cutting down the height of the bolster above the ground. A number of other minor changes were made which would adapt the trailer to this special service. For instance, instead of having stakes at the ends of the bolsters to retain the load, removable dogs are used which can be swung down off the bolster to permit of sliding the pipes off; whereas before, the casings had to be lifted over the stake or the stake had to be taken out.

All this may seem highly technical and of too special an application to concern the general public. But it teaches the moral that finished machines are not born but are bred. And if it induces a bit of patience with the manufacturers who are struggling with far more complex problems of the machine gun, the airplane, the Liberty Motor, the standardized ship, it will have served its purpose well.

The trailer that was adapted to hauling oil casings

Note the spring on the draw bar and the swivel bolster



Making a photograph of an eclipse with any camera

Photographing an Eclipse Without a Special Camera

IN connection with the eclipse of June 8th which will be total in certain parts of the United States and partial throughout the country, the method of photographing this phenomenon as illustrated in the accompanying illustration is of more than merely passing interest.

During an eclipse some time past, Prof. Jermain G. Porter, director of the Cincinnati Observatory, caused the image of the phenomenon to be projected on a piece of white paper in the manner shown, obtaining thereby a rather unusual silhouette photograph. Obviously, the photograph is made with any kind of camera, using the sheet of cardboard with its silhouetted image as the subject.

Letting Machinery Roll the Red-Cross Bandages

NO matter what the product may be, there is certainly a limit to hand work beyond which resort must be had to machinery. So it has been with the rolling of bandages for the Red Cross organization. Until recently these bandages of gauze were rolled by hand by numerous volunteers throughout the country; but with our increasing forces in France the demand for bandages is fast becoming so great that machinery has had to be introduced.

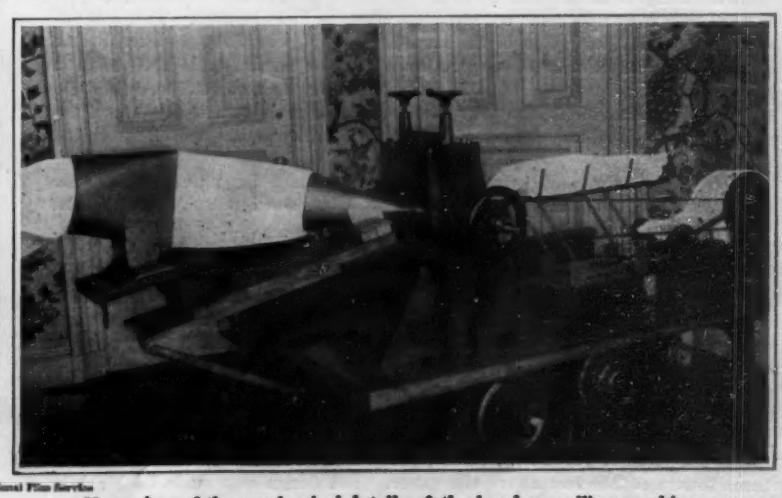
In the accompanying illustrations are two views of a recently devised machine for rolling surgical bandages. The gauze in the original roll is fed into a funnel-like member one end of which is quite flat, so as to fold the gauze in two as it emerges. From there the folded gauze travels in a continuous strip to another folder member which folds it in two, so that the material is one-quarter the original width and four-ply. It then passes between a pair of steel rollers under tension and is rolled up in a continuous strip on a suitable reel. If separate bandages are desired, a knife member can be actuated, cutting the bandages into any length desired and piling them on the adjustable stand between the rollers and the reel, as shown.

The bandage rolling machine is electrically operated. It is always under the control of the operator through the medium of a long pedal.

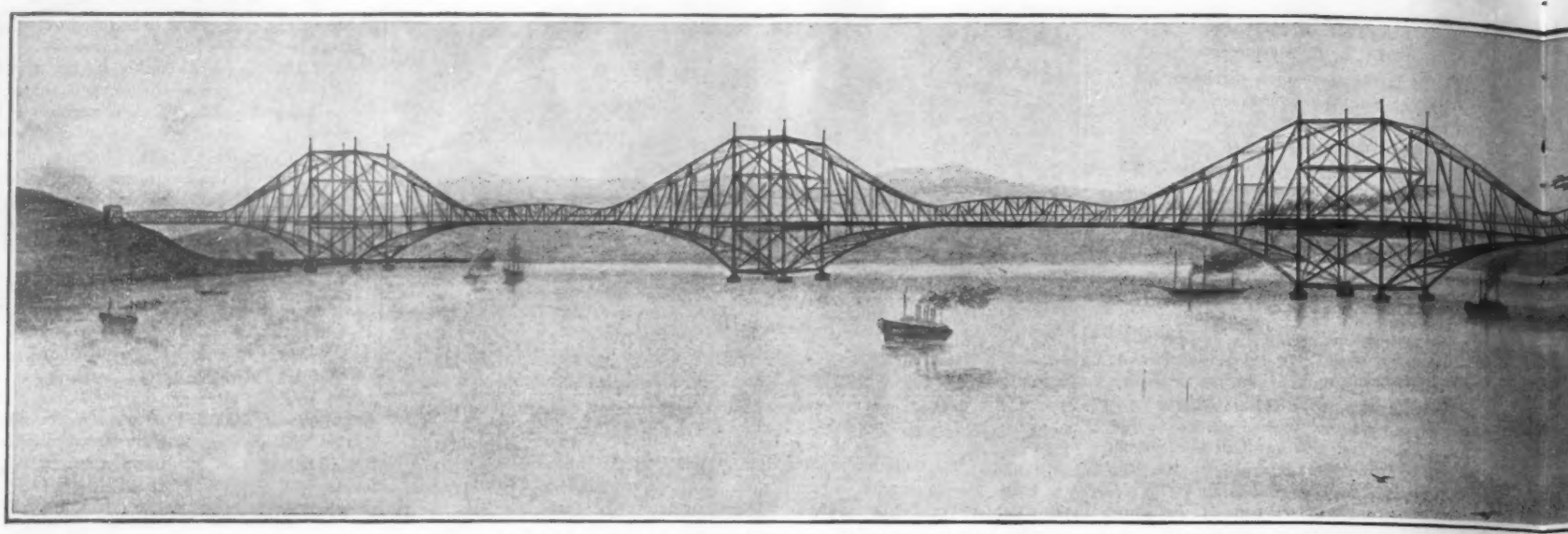
Condensed Goat's Milk

CALIFORNIA has a large ranch stocked with Swiss and Nubian goats, the milk from which is condensed and canned. Goat's milk is said to be very rich, and is in demand as nourishing food for invalids. A well-bred milch goat will produce 12 times its weight in milk. A cow produces yearly three times her weight if she is a good milker, but the goat can not be depended upon for a steady supply of milk at all times through the year. Therefore, it is said that canning is the best method of making a good dairy profitable. An 11-ounce can of condensed milk retails at 20 cents in the West, and the sale has thus far been confined chiefly to drug stores. The *Pacific Dairy Review* reports that goat dairying is a thriving industry in the West, and believes that canned goat's milk would find a wide sale if extended to the grocery trade.

This machine rolls surgical bandages from a roll of gauze



Near view of the mechanical details of the bandage rolling machine



Proposed Cantilever Bridge across San Francisco Bay. Total length, six miles. The portion of the bridge herewith shown contain

The Longest Possible Bridge Spans

Including Description of the Proposed Hudson River and San Francisco Bay Structures

By Charles Evan Fowler, M. Am. Soc. C.E.

THE need for longer spans for the bridges across the great rivers and harbors of the world has grown apace with the skill and science for their design, and the higher class of materials from which to fabricate them. The earliest attempts to construct bridges with what were in their time, long spans, doubtless were in the Orient, where crude forms of timber cantilevers were constructed, embodying the principles of our present day mammoth structures of this type. The lack of iron or steel made it necessary to resort to wood or stone, and what would be today a long-span stone arch, one of 251 feet span, was built over the Adda at Trezzo in Milanese, but was destroyed for military reasons by Carmagnola in 1416.

The first iron bridge of any importance to be constructed was in 1776, a cast iron arch of only 100 feet span at Coalbrookdale, England, and it is still in existence after 142 years of service. The longest timber span on record was the Liunnatbrucke of 390 feet span, built by Grubenman. The many timber bridges built in America had some comparatively long spans, one built over the Schuylkill by Louis Wernwag was an arch of 340 feet opening; and Thomas Pope in 1810 conceived a Flying Pendant Lever Arch of timber for East River at New York of 1,800 feet span, and one for North River of 3,000 feet span, both of which were, however, undoubtedly impracticable.

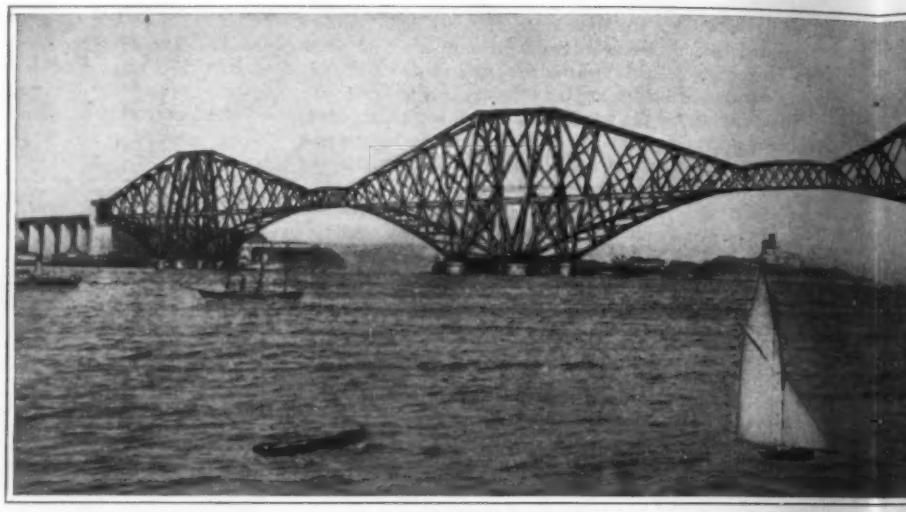
The real progress in metal spans was made in England where Telford constructed his eyebar suspension span of 580 feet at Menai Straits in 1819, and another of similar design at Conway Castle. The coterie of what we would today call bridge engineers, which was headed by Robert Stephenson, son of the inventor of the modern locomotive, and which included the famous scientists, Fairbairn and Hodgkinson, designed and built the famous tubular double track iron bridge over Menai Straits, in 1850, with two spans of 230 feet and two of 460 feet, and which may justly be termed the first long-span metal bridge. This structure was carefully calculated and designed on modern lines, all of the principal features of design being verified by elaborate experiments. There was also constructed a tubular railway bridge of 406 feet span alongside of the Telford suspension bridge at Conway Castle, and another much more extensive tubular bridge by Stephenson over the St. Lawrence River at Montreal, Canada, but having the longest span only 330 feet, although it contained 23 other spans of 242 to 247 feet each.

The other two greatest fundamental tests of the engineer's science and skill in bridge construction, were triumphs indeed. The Brooklyn bridge of 1595.5 span, begun in 1870 by John A. Roebling, and completed in 1884 was a wire cable suspension bridge, which is practically the longest span of this type ever built, although the Williamsburg bridge over East River is nominally five feet longer. The St. Louis arch bridge or Eads bridge over the Mississippi, built in 1868 to 1874, was undoubtedly the most remarkable ever undertaken up to that time, and in view of the facilities and materials available, may still be regarded as one of the world's most wonderful bridges, with its channel arch of 520 feet, and side spans of 502 feet.

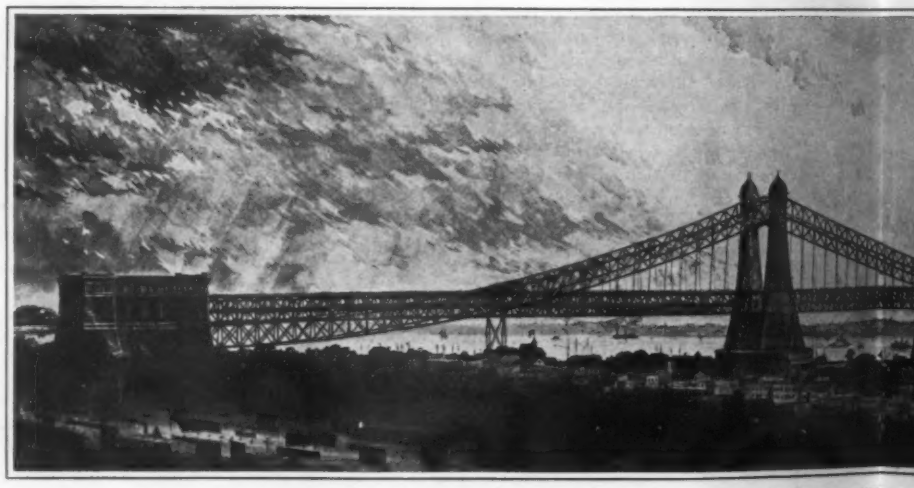
The most notable of the early simple truss spans of iron was the Cincinnati Southern bridge over the Ohio River at Cincinnati, with its 519 feet span over the channel, which was designed by Jacob Linville and built in 1876. This was followed by the 550 feet spans of the Huntington bridge in 1889; the Free Bridge at St. Louis, with three 668 feet spans, built over the Mississippi in 1910; and the Metropolis bridge over the Ohio River with its 721 feet channel span built in 1916. The Sciotoville bridge over the Ohio River recently completed, was designed by Lindenthal and consists of a two-span continuous bridge, each span being 775 feet.

There have been constructed during recent years a large number of other notable bridges, comprising suspension spans, cantilever structures, and arches. The Elizabeth bridge at Buda-Pesth is an eyebar suspension of 951.5 feet span and a very satisfactory structure in an architectural sense, although the Manhattan bridge of 1,470 feet span, a wire cable suspension bridge over East River near the old Brooklyn bridge is supposed to be the last word in bridge architecture. The Queensboro bridge over East River at Blackwell's Island is a cantilever structure with cantilever spans of 984 feet and 1,182 feet; which is only exceeded on the North American continent by the Quebec cantilever over the St. Lawrence River, with its span of 1,800 feet which is also the longest bridge span ever constructed in the world.

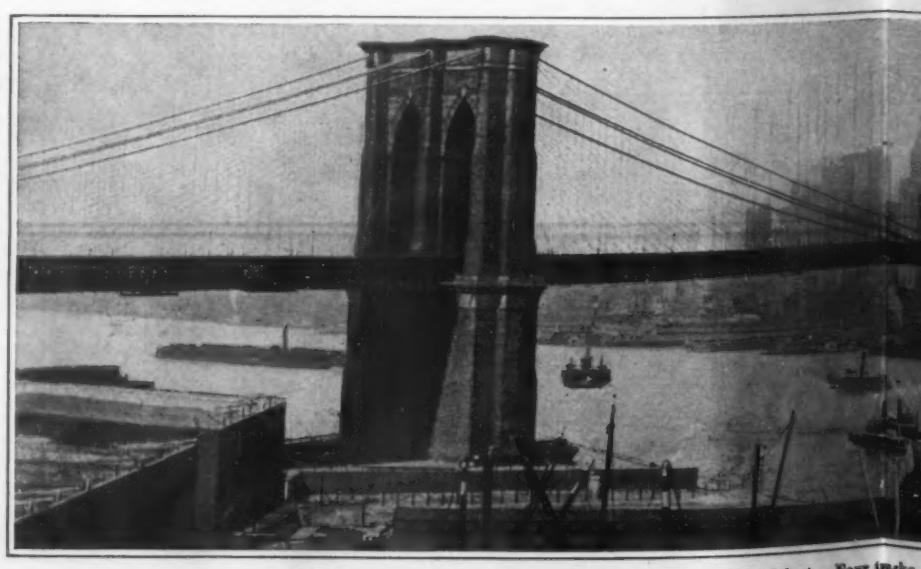
The greatest bridge in the world, all things considered, is the cantilever bridge across the Firth of Forth in Scotland, with its two spans of 1,710 feet each and three towers of 360 feet above the water. The design was made by Sir John Fowler and Sir Benjamin Baker in 1884, and the construction was in their charge



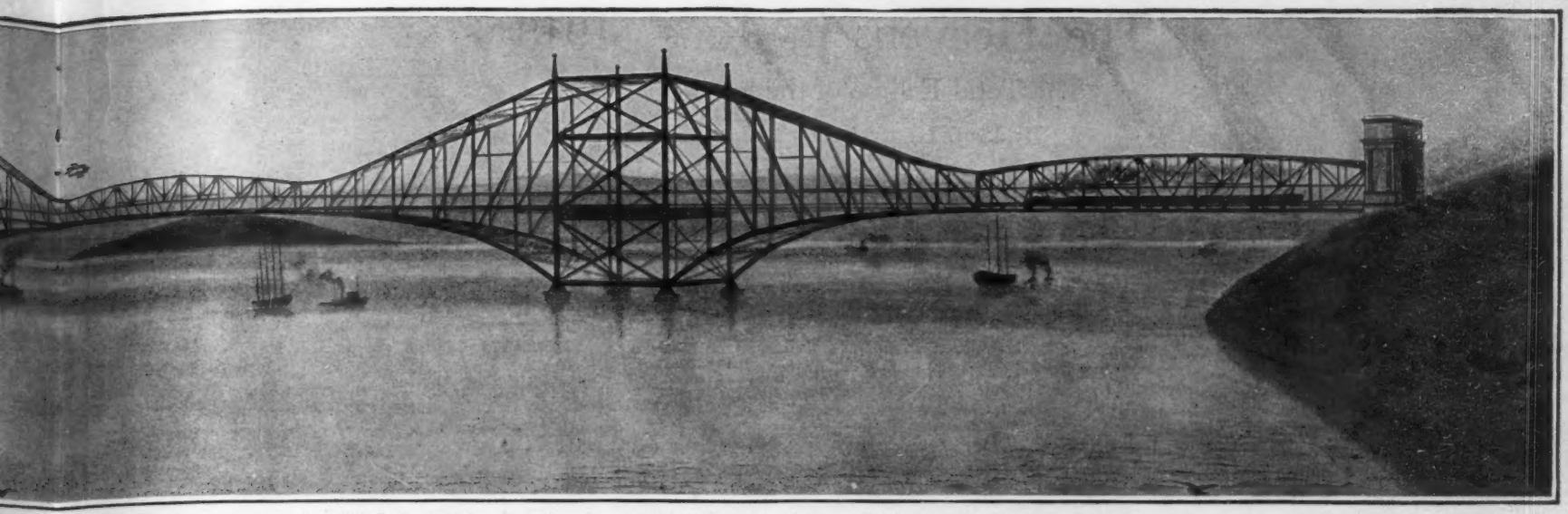
The Forth Bridge, containing two cantilever spans of 1,710 feet
Completed 1890. Enginee



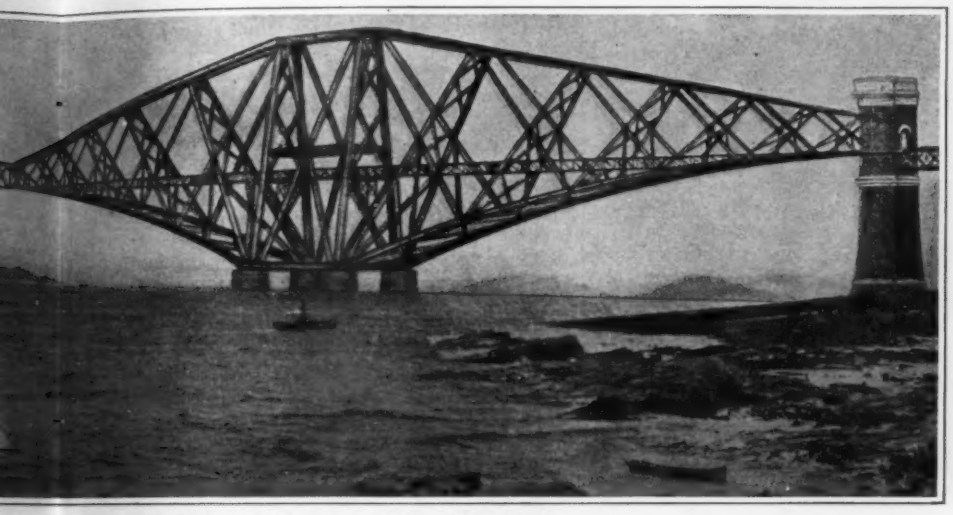
Proposed Suspension Bridge over the North River; main span 3,100 feet. Will carry



The Brooklyn Suspension Bridge; main span 1,595½ feet. Four tracks,



hown contains three cantilever spans each 2,000 ft. in length. Capacity, four tracks and two roadways. Engineer: Charles Evan Fowler



of 1,710 feet each. Total length, 8,098 feet. Two railway tracks.
90. Engineer: Benjamin Baker

t. Will carry fourteen railway tracks and two roadways. Engineer: Gustav Lindenthal

Four tracks, two roadways. Completed 1884. Engineer: John A. Roebling

during the entire period of six years required for construction. The bridge has a total length of 8098 feet and carries a double track railway.

It is supported on granite piers founded on great circular pneumatic caissons. There were 140,000 cubic yards of masonry and 50,960 long tons of steel used in its construction. The same engineers were called into consultation on the plans for a bridge over the English Channel, designed by Schreider and Hersent of Paris, which would have cantilever spans of 1,640 feet and a total length of 21 miles.

The arch bridge like the suspension, is fundamentally beautiful, and the engineer, when desiring a beautiful structure, instinctively considers one or the other of them as may best suit the location in view. Where there is a rock walled gorge as at Niagara, it may be considered the ideal location for an arch, so the Niagara and Clifton arch with its great span of 840 feet is a most beautiful and appropriate structure.

While, as we have seen, Pope proposed a timber arch of 3,000 feet over the Hudson; as will be seen later, a steel arch of 2,850 feet span for the same river was proposed in recent years, and although the theoretical span length of a steel arch exceeds 3,000 feet, there has never been found a practicable location where an arch could be constructed in excess of 1,000 feet span, which is practically the length adopted by Lindenthal for the Hell Gate four-track arch over East River at New York. This structure has a peculiar artistic charm, aside from its being an arch, and strange to say the same combination of curves of the top and bottom of the Hell Gate arch which were adopted for theoretical and practical reasons, coincide closely with the curves fixed by the Orientals for the camelback bridge in the Imperial Palace grounds at Pekin, China, and which was built many years ago.

The problem of crossing the Hudson River with a bridge has been under consideration for over one hundred years as we have seen, but it was not until less than a generation ago that a really feasible scheme was proposed by Gustav Lindenthal, M. Am. Soc. C.E., that for a great suspension span of 3,100 feet or nearly double the span of the greatest existing suspension span of 1,600 feet across East River; but it is only now when we have three tunnels under the Hudson, and others likely to be built, that the necessity for a bridge becomes imperative, as was pointed out in a recent editorial in the SCIENTIFIC AMERICAN. This great span is planned to carry, on the great cables stretching between the 500 feet towers, eight railway tracks, six rapid transit tracks, and two roadways each for three lines of traffic. Connecting with a classification yard in New Jersey, which would be reached by all the railways, traffic would be carried to a series of stations on Manhattan Island where freight would be distributed with a minimum of trucking.

The passenger traffic would be handled through a great Manhattan station, the upper level for the railways, having also connections with the Pennsylvania and New York Central stations; and the suburban traffic on the lower level, with connections to all New York Rapid Transit lines, and reaching across to all parts of Jersey. The various details of the plan as outlined in a recent prospectus, indicates it to be the most comprehensive plan ever proposed for caring for the traffic and freight handling of the Metropolitan Port District. The coordination of the present Harbor facilities is fully provided for, and the plan invites the construction of other essential improvements, such as a system of trans-Atlantic terminals where rail and vessel can meet without loss of time and with a minimum of expense. Regardless of whether highway tunnels can be ventilated, the bridge will offer the only real route for auto traffic, both as regards light and air, together with the necessary capacity for a Metropolitan population which in the not far-distant future will reach ten or twelve millions.

The length of spans which can economically be built, will interest many of the nations after the war; but in the United States there are many cities needing improved facilities, which are proportionately as necessary as those for New York City, and most important of these will be for the great ports of the Pacific coast, which must care for a rapidly increasing commerce. While a steel arch of 2,850 feet span was worked out in 1889 in some detail for a crossing of North River at New York, the designer overlooked the fact that foundations adequate for such a structure could not be provided for under existing conditions.

There are likewise underlying reasons why a cantilever design is the most suitable for a bridge for a real rapid transit crossing of San Francisco Bay. The natural location for such a structure is at Goat Island, where the three 2,000 feet spans proposed by Charles Evan Fowler, M. Am. Soc., C.E., would connect with Telegraph Hill in San Francisco and by means of an approach about 20,000 feet long, connect Goat Island with the Oakland shore, thus providing a main structure over six miles in length. These spans with the present available class of steel, would be more easily constructed than was the Forth bridge in the Eighties. There would be required about 350,000 cubic yards of masonry and 300,000 tons of steel. Such a structure would provide ample clearance for large ships and would have four tracks and two roadways. The great traffic of about

(Concluded on page 511)

The Heavens in June, 1918

The Total Eclipse of the Sun June 8th

By Prof. Henry Norris Russell, Ph.D.

THE one great event of this month, from the astronomical viewpoint, is the total solar eclipse of June 8th, which, as every one knows, will be visible in the United States. Though of short duration, this is the first total eclipse visible in this country since that of May 28th, 1900, and it is, therefore, certain to attract wide attention, both among astronomers and with the general public; and, in spite of the existing war conditions, it will be widely observed if the weather permits.

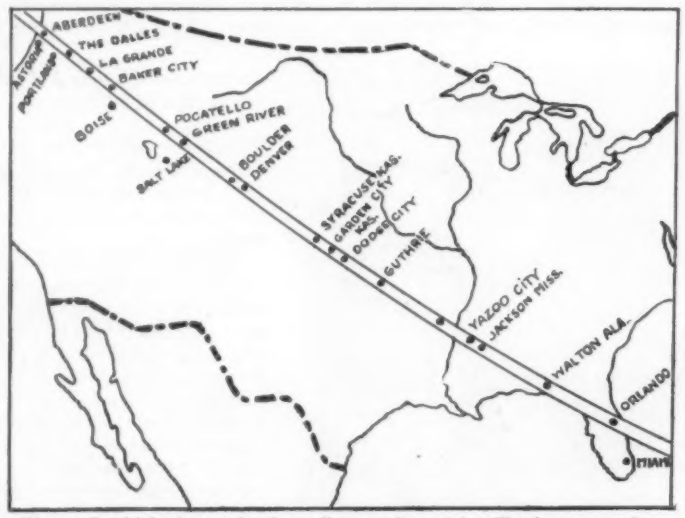
At the moment of new moon, which is 4:27:4 P. M. by the new eastern standard summer time, the moon is nearly in line between the earth and the sun. To be exact, the center is 1,845 miles north of the line joining the centers of earth and sun; and, since this is less than the earth's radius, the shadow falls on the earth. Since the sun is almost exactly 400 times the diameter of the moon, the moon's shadow tapers down to a point at a distance of 235,600 miles, the distance at which sun and moon would look equally large. But the distance of the moon from the earth (from center to center) at this time is only 232,280 miles; hence, if a screen could be set up, passing through the center of the earth and facing the sunlight, the tip of the moon's shadow would reach 3,220 miles beyond this screen, and the true shadow, or umbra, would fall on the screen in the form of a small black spot, 29½ miles in diameter, surrounded by a partly illuminated region, or penumbra, from which most, but not all, of the sunlight would be cut off. As the moon moves in her orbit, this spot would move eastward across the screen at the rate of 2,200 miles per hour, or 36¾ miles per minute, so that, if it passed centrally over any spot on the screen, the sun would appear completely obscured for an interval of only 48 seconds.

But the shadow actually falls on the curved surface of the earth, which is nearer the moon than our imaginary screen; hence, on account of the tapering of the shadow, it will be more than thirty miles in diameter where it actually meets the surface of our world. Moreover, points on the surface of the earth are not at rest, but are moving eastward, on account of the earth's rotation, at a speed of almost 1,060 miles an hour at the equator, and of over 800 miles an hour in the latitude of Washington. The shadow, passing over the moving surface, has to overtake the objects on it, and hence it takes longer than it otherwise would to pass over a given point.

In the present instance, the shadow first strikes the earth at a point in the Pacific, about 500 miles south of the southernmost point of Japan. It sweeps eastward and at first northward, across deep water, passing only over one or two tiny islets, and missing the Aleutian Islands by a couple of hundred miles. Then, turning somewhat to the southward, it reaches the American coast somewhat to the south of the Canadian border, and crosses the country diagonally from northwest to southeast. It passes just north of Portland, Ore., directly over Denver and Jackson, Miss., skirts the Gulf Coast of Florida, and finally passes out to sea in the direction of the Bahama Islands, where it leaves the earth's surface, three hours and ten minutes after first having reached it.

At the middle point of this long track, in the North Pacific 700 miles south of the Alaskan coast, the surface of the earth is 3,500 miles nearer the moon than is the earth's center; hence, as may easily be calculated, the shadow is increased in diameter to 62 miles, more than double what it would be on our imaginary screen. At the same time this region of the earth's surface is carried eastward by its rotation at the rate of 640 miles per hour, so that the shadow overtakes a point on it at the rate of 1,560 miles per hour. It follows that the shadow will take 143 seconds, or a little more than 2¼ minutes, to pass over this point, and this is the maximum duration of the total phase of the eclipse. By the time that the shadow has reached the American coast, the curvature of the earth has carried it further away from the moon, and made it smaller, while the rotation of the earth is partly in a direction away from the moon, so that the shadow overtakes points on the surface more rapidly. These influences cause the duration of totality to diminish, but it is still a little over two minutes for points on the Pacific coast. The further the shadow proceeds, the greater do these influences become, so that totality lasts only a minute and a half in Colorado, and less than a minute on the east coast of Florida.

These statements hold good only for points exactly on the track of the center of the shadow; for observers north or south of this the duration will be less, and, outside a narrow strip of country, the sun will not be completely obscured at all. The width of this track diminishes from about 70 miles in Oregon to a little over 50 miles in Florida. It is greater than the actual diameter of the shadow, because the latter falls on the earth's surface obliquely, and is thus spread across it in an ellipse, instead of forming a true circle.



The path which the total solar eclipse of June 8th will take across the United States

What the Eclipse Will Look Like

From all points within this narrow zone, the sun's direct rays will be completely cut off for between one and two minutes. Though so short in duration, the eclipse will be well worth a long journey to see. From the standpoint of the average man, the greatest interest of the sight will beyond a doubt be its extraordinary character as a spectacle. It is one of the most impressive of natural phenomena. As the moon advances further and further across the sun, the light fades, and it seems like late afternoon. Then, as the light from the edge of the sun differs in quality from that of the sun as a whole (containing a greater proportion of red and less of blue), the landscape and sky take on strange and unearthly colors. The darkness increases, and during the last minute before totality the whole world seems to darken like a train entering a tunnel. Observers with a clear view westward may see the shadow coming, obscuring earth and sky, with enormous speed. It reaches one's station—the sun has vanished, and it is dark. In a moment one begins to realize that it is not pitch dark, but like a moonlight night. The brighter stars are visible, but not the fainter ones, and all around the horizon—where the sun is still shining undisturbed fifty miles and more away—there seems to be a bright twilight. On the blue-black sky where the sun was appears the dark circle of the moon, distinctly silhouetted against the silvery and irregular outline of the solar corona.

Almost before the watcher has time to take these things in, a brilliant speck of light appears on the moon's western edge, and grows in a moment to a narrow but dazzling crescent. The sunlight returns, and totality is over.

Granted only the good fortune of clear skies, this series of events is well worth a long journey to behold. But the astronomer does not travel half-way round the world merely to see a sight, however wonderful. His aim is to add to human knowledge. We all know how, in the past, observations at the time of total eclipse have proved that the scarlet prominences which appear here and there along the edge of the eclipsing moon are really vast clouds of incandescent gas hovering above the sun, and millions of miles beyond the moon; that the sun is surrounded by an atmosphere of incandescent gases, whose absorption produces the well known dark lines in the solar spectrum; and that the mysterious corona, which extends sometimes to a distance of millions of miles from the sun, is also a true solar envelope, composed mainly of fine particles of dust or fog of some sort, but containing also some self-luminous gas which has not yet been identified on earth.

What the Eclipse Means to the Astronomer

But much remains to be done. The spectrum of the sun's atmosphere, as revealed just at the moment when the brilliant photosphere has just disappeared behind the moon, deserves further investigation—by photography, of course, for in no other way can records of hundreds of spectral lines be secured in a single second—especially with a view of determining more precisely what constituents are most prominent in the lower, middle and upper layers of the solar atmosphere. The corona still presents many problems—the measurement of its heat radiation, of the polarization of its light which shows that much of this light is apparently reflected from very fine dust, and the further investigation of its perplexing gaseous consituents, which do not seem always to be present in the same relative proportions.

Then the few moments of complete darkness may be utilized for other investigations, possible at no other time. One of these, the search for a planet nearer the sun than Mercury, may now be considered closed, since three careful photographic searches by parties from the Lick observatory have found nothing. But a new problem has been presented in very recent years, by the development of that most remarkable physical generalization known as the principle of relativity. According to the later and more complete form of this theory, a ray of light passing close to the sun, or to any other massive body should be curved slightly inward; so that a star whose rays had passed within a few hundred thousand miles of the sun should appear to be slightly shifted in position.

Though theoretically a similar effect should be produced by other bodies, such as the moon or Jupiter, calculation indicates that an effect big enough to observe should take place in the case of the sun alone, where the shift exceeds a second of arc, and could be very readily measured on photographs taken with modern telescopes. To find out whether this predicted shift really occurs we must evidently observe during a total eclipse, and must have enough stars near the sun to get half a dozen or so on our plate within the available exposure time, for if there were

(*Concluded on page 511*)

At 12 o'clock: June 7.
At 11½ o'clock: June 14.
At 11 o'clock: June 22.

At 10 o'clock: July 7.
At 9½ o'clock: July 14.
At 9 o'clock: July 22.

At 10½ o'clock: June 30.

The hours given are in summer clock time.

NIGHT SKY: JUNE AND JULY

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

FASTENER FOR COLLARS AND THE LIKE.—A. GRIFFITH, 200 North Second St., McAlester, Okla. This invention relates generally to garment fasteners, but more particularly to fasteners for securing collars and the like, the

DETAIL PERSPECTIVE VIEW WITH THE TWO PLATES HELD APART

object being to provide a button carrying member capable of utilization at the rear of the neck-band of a shirt, for effective use irrespective of the usual buttonhole, and without perforation of the goods at this point of the collar band.

ADJUSTABLE CAP.—J. TIM, 116 W. 72d St., Apt., 16B., New York, N. Y. The general object of this invention is to provide a cap which is adjustable as to size so that it may be worn by different persons with equal comfort and fit in the proper manner, whereby retailers need keep but one size in stock. The cap is provided with a plurality of plackets in the rear part whereby the user can easily and quickly adjust the size to fit his head.

Electrical Devices

ELECTRODYNAMIC MACHINE.—A. N. SAMMARONE, 2624 E. 115 St., Akron, Ohio. The invention relates particularly to commutator supports in this construction the insulation is held securely in position in such a manner that the commutator bars are gripped firmly, thereby preventing any danger of becoming loosened in the operation of the machine. The construction further provides for quick dismantling of the commutator for repair or replacement of any particular commutator bar.

TERMINAL CONNECTOR FOR ELECTRICAL CONDUCTORS.—O. ZIMMERMAN, 770 E. 179th St., Bronx, N. Y. The invention has for its general object to provide a terminal of a double eyelet type for flexible electric conductors which can be made of sheet metal easily cut and formed under a punch press and firmly attached to a conductor with specially formed pliers or hand clamps to firmly bind both the naked and insulated ends of a flexible conductor and prevent stripping or unraveling of the insulation.

Of Interest to Farmers

PEA AND BEAN SEPARATOR.—G. E. PRITCHARD, Elizabeth City, N. C. The invention relates to a machine especially adapted for harvesting and threshing peas and beans, and more particularly to that type of machine adapted to be drawn over the field and provided with guide means to direct the vines of a row properly into the beater for threshing, means being provided for moving the peas or beans rearwardly in the machine.

CORN GRADER AND SEPARATOR.—J. A. WORSHAM, Marca, Ill. This invention relates to a grading machine primarily designed to grade ground or cracked corn, the object is to provide a simple and inexpensive machine which is characterized by stationary sieves mounted to vibrate to prevent clogging and disposed to feed the material on the sieves gravitationally.

Of General Interest

PERCOLATOR.—P. MALCAMP, cor. Derbigney and Frenchman Sts., care of Mrs. Charbounet Druggist, New Orleans, La. The object of the invention is to provide a percolator in connection with a heater, wherein the arrangement is such that when the operation of making coffee is complete, the burner will be extinguished, and a signal will be sounded to notify the housekeeper, the operation is entirely automatic, being brought about by the completing of the operation of coffee making.

FLUSHING DEVICE.—N. J. GONDOLF, 703 State St., New Orleans, La. The invention relates to a flushing device in which the float is depressed to start the siphon and the features relating to the float and inlet valve are associated with a jet starter tube and with an after fill tube. The invention relates particularly to means to actuate the float carrying structure, to actuate the siphon starter jet and after fill, also to means to retain the float in depressed position and to prevent it rebounding.

PORTABLE GARBAGE PLANT.—H. LAMBERTS, Bellevue-Stratford Hotel, Philadelphia, Pa. The invention relates to a portable gargabe disposal plant which may be moved from place to place as occasion demands. The main object is to provide a garbage plant located on a vessel or boat which can proceed under its own power from place to place, or be towed to the location which is desired, if necessity arises the plant may receive the garbage at a city dock and proceed from the city to carry on the subsequent operation.

EXPOSURE METER.—L. R. DICH, care of State University, Missoula, Mont. The object of the invention is to provide an exposure meter, for use in connection with photography, having a screen which will allow only those rays to pass through which are photographically effective. The device is in the form of a disk having a plurality of apertures of different sizes disposed symmetrically on the circumference the disk is provided with a scale. The light coming from the object to be photographed is caused to pass through a color screen before it passes through the apertures in the dish, the disk is turned to the smallest opening at which the object to the eye in desired brilliancy, the time of exposure is found indicated at the side of the opening.

PICTURE DISPLAY HOLDER.—W. S. RUSSELL, Massachusetts Chambers, Boston, Mass. Among the objects of the invention is to provide a holder for the successive display of a series of pictures relating to similar or different subjects and mounted or formed upon a continuous card or slip for longitudinal adjustment along the holder, means being provided to accurately position each picture for display.

JASS STAGE.—T. D. BREEN, 1013 Church St. Richmond Hill, L. I., N. Y. The invention relates to a stage to be used for illusions, dancing balancing, juggling, acrobatic and musical comedy tricks. The stage is formed of a series of sections each provided with a plurality of movable disks. A complete unit or stage consists of 12 sections, but the number may be varied according to the size of the stage. Each of the sections has four movable disks all actuated from the same driving unit.

NEGATIVE HOLDER.—I. S. BUNNELL, 16 Nassau Place, East Orange, N. J. The object of the invention is to provide a negative holder arranged to permit of holding negatives provided with alphabets of fancy capital and small letters or other fancy characters varying in height and to permit accurate positioning of a selected character for making an exposure on the sensitized film at the same time insuring accurate spacing between successive characters in the formation of words and sentences.

NUT LOCK.—B. G. PATTERSON, care of Patterson Lock Nut Mfg. Co., 14 E. Jackson Bldg., Chicago, Ill. The invention relates generally to nut locks, but more particularly to that type of nut lock including nut carried locking means in the form of an element for engaging with portion of the threads of the bolt to securely lock the nut against rotation in one direction, at the same time permitting the nut to freely move upon the bolt in the opposite direction.

CURTAIN POLE.—F. J. BISCHOF, 759 Townsend St., Detroit, Mich. The invention has for its object to provide a curtain pole having a guide with a slot in its bottom, a hanger extending upwardly in the slot and provided with rollers rotatably mounted at its sides for engaging the guide at the sides of the slot. The guide is preferably mounted in a casing having a slot through which the hander extends.

COMBINATION BARREL FOR SWEEPING COMPOUNDS.—I. H. WEBB, Brookville, Pa. An object of the invention is to provide a receptacle for storing and shipping sweeping compounds which contain oil, it consists in utilizing an ordinary wooden barrel by fixing a metal pan in the bottom to catch the oil from the compound and prevent leakage, a tube is packed into the barrel to give access to the compound near the bottom where the compound having the desired percentage of oil may be scooped out.

CASKET LOWERING DEVICE.—C. A. PURVIS, Versailles, Mo. The object of the invention is to provide a device for lowering caskets into graves, wherein spring and governor-controlled lowering mechanism is provided, capable of supporting the casket above the grave and having releasing mechanism for releasing the same to permit the casket to be lowered by its own weight.

HORSE TWITCH.—H. W. MCCALL, Scotia, Neb. This invention relates to an instrument to be applied to a horse's nose to control the animal while administering medicine, shoeing or the like, and particularly relates to that type of device

PARTLY SECTIONAL SIDE ELEVATION SHOWING DEVICE AS APPLIED TO THE ANIMAL

in which a loop is passed onto the nose or upper lip and then tightened so that the device is suspended in position. The device may be successfully employed in situations where a second man is not present or available to render assistance.

PROTECTIVE AND NON-PENETRATIVE COVERING AND THE LIKE.—G. LYNCH, address Barbed Wire Traversor Co., Whitehall House, London, S. W. 1., England. The invention relates to protective and non-penetrable coverings to be employed for military and other purposes. The invention consists of wool or cotton wool impregnated while in its normal loose or fluffy condition with powdered dry resin, which is sticky or adherent at normal temperature it becomes, while retaining its normal loose or fluffy condition more or less non-penetrable by sharp points, such as points of barbed wire, bayonets or the like, and stops or very materially resists the passage of flying articles such as bullets, shrapnel or other flying fragments.

Hardware and Tools

BRICK JOINT RAKER.—F. M. COLLINS, 1920 8th St., N. W., Washington, D. C. The invention relates to tools for raking out a uniform portion of the mortar between bricks. The device is simple and unexpensive to manufacture, will permit of the ready escape of the mortar, and avoid collection of the same upon the faces and edges of the bricks near the joints. The device is so constructed that it will not sink at anytime beyond a given point into the mortar joint.

DOOR BUFFER.—D. E. OLIVER, 2610 E. 14th St., E. Oakland, Cal. The object of the invention is to provide a cushioning device and an actuating member for the device arranged not to interrupt the door on the latter closing easily, but on the door moving shut with more than ordinary force to interupt the closing movement and to cushion it without damage to the door, the buffer door casing and other connected parts.

ADJUSTABLE OVERFLOW ATTACHMENT.—A. E. MUELLER, 1633 4th Ave., Louisville, Ky. The object of the invention is to provide a construction adapted for bath tubs, wash basins, and the like, whereby any desired height of water may be secured within certain limits. A still further object is to provide an attachment adapted to fit over the usual waste pipe, held by a clamping member, in any adjusted position, so that the water level may be determined regardless of the position of the waste pipe opening.

JACK GUIDE.—A. E. HALL, 1811 Waterloo Place, Bronx, N. Y. The invention relates to a holder for jacks, the object is to provide a construction which coacts with the jack for holding it in place while being operated for elevating an article. Another object is to provide a guide for an automobile jack which is provided with an operating claim whereby the jack may be forced under the axle without the operator getting under the automobile, the invention is provided with a removable handle whereby the jack may be placed at any desired point under an object while the workman remains at a given point.

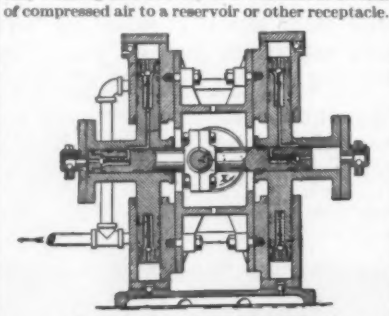
MEANS FOR THE REMOVAL OF BOTTLE AND LIKE CAPS OR STOPPERS.—F. SUNDERLAND, Birmingham, England. The invention comprises means for the ready and convenient removal of the well known crown or like metal capped stoppers of bottles, jars, and similar vessels, the tool comprises a looped or double handle part provided with a drag piece adapted to engage the rim of the cap, which may be removed either by a depression or an elevation of the handle of the tool, the handle part being placed across the cap so that one side of the latter shall form a fulcrum.

Heating and Lighting

FOLDING BED.—M. COX, 651 Third Ave., New York, N. Y. The object of the invention is to provide a folding bed arranged to provide a rack extending across the front of the head stand adapted to hold pillows, blankets, or other bed clothing or articles, as suits the convenience of the user, the rack being arranged within the space extending between the head and the bed spring frame at the time the latter is in upright folded position.

Machines and Mechanical Devices

AIR COMPRESSOR.—H. FLEMING, 748 50th St., Brooklyn, N. Y. The object of the invention is to provide an air compressor arranged to insure easy running and delivery of a continuous stream of compressed air to a reservoir or other receptacle.



A LONGITUDINAL CENTRAL SECTION

Another object is to render the air compressor exceedingly compact in construction and to balance the parts with a view to reduce friction and vibration to a minimum.

ADDING MACHINE.—F. W. CARSON, R. F. D., No. 1, Lakeside, Cal. This invention has for its object to provide a machine by means of which sums in either addition or subtraction may be done. The device comprises a shaft, a series of number wheels journaled thereon, means in connection with each wheel for engaging the succeeding wheel to move it at predetermined intervals, means secured to the shaft adjacent each wheel for controlling the engaging means, the engaging means being controlled by the means on the shaft when the wheel is moving in either direction, and means for moving the shaft a predetermined position for varying the position of the means on the shaft with respect to the wheel.

WASHING MACHINE GEARING.—F. P. UHRIG and C. C. STRANGE, address, Fredrick P. Uhrig, Bellevue, Idaho. A specific object of this invention is to provide an arrangement and design of power transmitting means whereby the power can be thrown on or off to operate the washing machine agitator or the wringer, the wringer being so mounted that it can be thrown laterally to and from an operative position with regard to the washing machine without altering the driving connections with the wringer. Still another object is to provide means for oscillating the agitator of the washing machine part of the means being associated with the hinge between the cover and body of the tub whereby the cover can be opened or closed without altering the operative connections between the power transmitting machine and the agitator.

Prime Movers and Their Accessories

HEAT ABSORBING SYSTEM FOR INTERNAL COMBUSTION ENGINES.—G. B. GIFFORD, Jr., 35 W. 36th St., Bayonne, N. J. This invention relates to what may be termed heat absorbing systems for internal combustion engines, the object is to provide a construction whereby the heat absorbed from the engine is communicated to air supplied to the carbureter. Another object is to provide a cooling system whereby radiators for internal combustion engines for automobiles, or other purposes are eliminated, and to provide a more uniform condition in respect to the heat of the cylinders and the incoming fuel.

Railways and Their Accessories

BOX CAR LINING.—J. DICKSON, address Miller and Wilkinson, Attys., United States National Bank Bldg., Vancouver, Wash. The invention relates to linings for box cars, horse cars, etc., an object is to provide a removable lining which may be used when comminuted material such as coal, grain and the like is shipped, a lining which will protect the sides of the car and which will also prevent loss of material, yet may be removed or replaced with a minimum of labor.

Pertaining to Recreation

AMUSEMENT APPARATUS.—G. MONGILLO, 24 Poplin Ave., Bradford, Pa. The object of the invention is to provide an apparatus, wherein a series of truss beams is provided, mounted intermediate their ends on a common axis to swing each in a vertical plane, each beam carrying at its ends seats, mechanism being provided for connecting the beams to a motor to operate the same, and clutch mechanism interposed between the motor and the beams, together with a brake for checking the swinging of the beams.

Pertaining to Vehicles

TRACTOR CONTROL.—F. A. MCDANIELS, 1253 Minnesota Ave., Portland, Ore. The general object of the invention is to provide a comparatively simple controlling mechanism which is reliable and efficient, so designed that by means of a single lever the vehicle can be guided as to direction and speed of travel, that is to say, by movements of the lever, it can be driven straight forwardly or straight rearwardly or can be turned to the right or left either forwardly or rearwardly, the invention provides for mechanisms between the engine and the traction elements.

RESILIENT WHEEL.—LA ROY B. CARRIS, Sioux Rapids, Iowa. The invention has for its general object to provide a tire for taking the place of the pneumatic tire, wherein resilient mechanism is provided within the usual shoe or casing, possessing practically all the advantages of the pneumatic tire, but will not be lessened in resiliency by puncture or blow out, coil springs are arranged between the shoe and the demountable rim, the ends of the springs engaging abutments.

VEHICLE LAMP.—C. SCHICKERLING, 511 Union Place, Union Hill, N. J. The invention relates to lamps or headlights for automobiles or other vehicles and has particular reference to the provision of means for illuminating the roadway at the sides as well as in the front. Among the objects is to provide an electric lamp with a multiple reflecting device and a plurality of sources of light whereby one portion of the light is reflected forwardly, and another laterally or rearwardly depending upon the various uses to which the lamp may be applied.

AUTOMOBILE TRANSMISSION LEVER EXTENSION—C. F. YOUNG, General Sales Co., 3952 Ludlow St., Philadelphia, Pa. This invention relates to an automobile speed control lever extension which can be easily and quickly secured to the lever and thereby permit operation of the same without moving the body while driving a car. The invention is characterized by an L-shaped rod which has means for engaging the lever so as to be presented in proximity of the seat from which the car is operated.

AUTOMOBILE LAMP BULB.—C. SCHICKERLING, 511 Union Place, Union Hill, N. J. Among the objects of the invention is to produce a lamp bulb, especially for headlights, having inherent within itself a reflecting medium whereby the principal part of the light from the filament is adapted to emerge both directly through the front part of the bulb and indirectly from a reflecting surface formed on the back portion of the bulb, the front part being provided with light modifying means.

Designs

DOOR HANDLE.—W. M. HEALEY, care of Healey & Co., Broadway and 51st St., New York, N. Y. This design represents a door handle constructed in T-shape form, at the top or grip portion, on either side of the center, is an oblong hollow space.

DESIGN FOR A PICTURE FRAME.—J. E. TONDL, 1336 First Ave., New York, N. Y. This ornamental design represents an oval opening surmounted by the American Eagle, United States flags, rifles, cannon and amunition on either side, the liberty bell at the lower portion, and on the base the words "The Spirit of 1917."

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Oil Tests

Their relation to Correct Lubrication

This important 8-minute talk is based on the 50 years' world-wide experience of the Vacuum Oil Company

SEVERAL years ago a prominent engineer invented a machine to determine the comparative efficiency of lubricating oils. But one day it was found that crude kerosene oil, by this machine's test, was the best lubricant.

That ridiculous result will indicate the difficulties which science has always met in trying to judge an oil's efficiency by anything but the practical tests of *service*.

Nevertheless, *during manufacture*, certain scientific tests are essential. For example: Each batch of Gargoyle Mobiloils is put through at least 35 separate and distinct tests. These tests are *not* aimed to get at the *lubricating efficiency* of the oil. That can only be determined by the test of *service*. The scientific laboratory tests simply make sure that the oil is running uniform. Below we outline briefly a few of the tests used for this purpose.

VISCOSITY TEST

Viscosity is simply the technical name for what is popularly called "body."

But this fact must be borne in mind: Two oils which will show the same viscosity at one temperature will often decidedly differ in viscosity at higher or lower temperatures.

The viscosity of Gargoyle Lubricants is tested at three different temperatures—104°, 140° and 210° F.

In this test the oil is put into a tube surrounded by water or steam which is kept at the test temperature. When the oil reaches the predetermined temperature, a plug in the bottom of the tube is removed. This opens a small standardized tube. The oil is then allowed to flow out of this opening into a glass receptacle of known capacity.

The time in seconds required by the oil to fill the container beneath, up to the standard graduation mark, is the measure of the oil's viscosity.

Gargoyle Lubricants all go through the viscosity test, but the viscosity test alone cannot determine the efficiency of an oil. Gargoyle Lubricants possess individual characteristics as lubricants.

GRAVITY TEST

In this test a weighted bulb with a graduated spindle (hydrometer) is dropped into a tube of oil. The hydrometer floats. But its bottom sinks to a certain depth—depending on the oil's gravity. The gravity is determined by the depth to which the hydrometer sinks, as shown by the markings on the spindle with the oil at 60° F.

This test is simply used to determine whether or not uniform weight per gallon is being maintained. It is constantly used in manufacturing Gargoyle Lubricants.

FLASH AND FIRE TESTS

The flash test is the lowest temperature at which the vapor from an oil will ignite but not continue to burn. If the flash test is too low, the oil will evaporate from the cylinder walls and bearings when the normal engine heat develops. This would leave the friction surfaces without lubrication.

Gargoyle Lubricants always undergo this flash test.

The fire test is made with the apparatus used in the flash test. The fire test is the temperature at which the ignited vapor from an oil will continue to burn.

This is another check used in manufacturing Gargoyle Lubricants to insure uniformity.

But it should be remembered that the flash and fire tests alone cannot determine an oil's lubricating efficiency.

IMPURITY AND WATER TEST

Crude oil comes from the ground. It is liable to contain traces of salt, mud, sand, water and other foreign substances held in suspension.

The crude oil which is subjected to this test is mixed half and half with gasoline and poured into a graduated glass sedimentation jar. The jar is then put into a centrifuge and whirled.

During the whirling process the bottom of the jar is thrown outward. The water and foreign substances are forced into the small, graduated end of the jar. The organic foreign substances form a layer between the water and the oil, the sand sinking to the bottom.

The graduated scale indicates the percentage of water and of foreign substances in the sample under examination.

THE foregoing are, of course, but a few of the 35 separate and distinct tests which are used in the manufacture of Gargoyle Mobiloils. To describe *all* of these tests in this space would be impossible.

But we have tried to make plain the great difference in efficiency which may exist between oils which *look* alike, *feel* alike and *test* alike. To cope with this puzzling condition, the Vacuum Oil Company has for years maintained thoroughly equipped laboratories and engineering departments in many parts of the world.

In recommending a Gargoyle Lubricant for a given purpose, we first analyze the operating conditions to be met, then specify the lubricant which is known from practical experience to meet the conditions most efficiently.

With Gargoyle Mobiloils this situation is met by a Chart of Recommendations which is shown in part on this page. The oils specified for the various cars on this Chart are determined annually by a careful engineering analysis of each model and make of car.

The recommendations are based on 50 years of practical experience in lubrication. The formulæ and methods used in manufacturing these oils are based on almost numberless practical tests.

You may safely feel that the oil specified for your car in this Chart will insure—Greater power. Less friction. Less carbon. Lower consumption of gasoline. Less consumption of lubricating oil. Longer life of your car.

GARGOYLE

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If the dealer has not the grade specified for your car, he can easily secure it for you.

VACUUM OIL COMPANY, New York, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world

Domestic Branches: Detroit, Boston, Kansas City, Kan., New York, Chicago, Philadelphia, Indianapolis, Minneapolis, Pittsburgh, Des Moines

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A." "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

This Chart is compiled by the Vacuum Oil Company's Board of Engineers and represents our professional advice on Correct Automobile Lubrication.

AUTOMOBILES	1918		1917		1916		1915		1914	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott	Arc	Arc								
Abbott-Detroit			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	A	A	"	"
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	A
Apperson	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Auburn (4 cyl)					A	Arc	A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-39 & 6-39)			A	Arc	A	Arc				
" (6-39B)(Teetor H)	A	Arc								
" (6-39B)(Cont'l)	Arc	Arc								
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)					A					
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Cadillac	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Case	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers	A	A			Arc	Arc	Arc	Arc	A	A
" (6-40)					A	Arc				
" (6-36)			A	A	A					
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (3 cyl)	A	A	A	A						
" (F A)	A	Arc								
Cole					Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A	A	A		
Cunningham					Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Dart	A	Arc	A	Arc	A	Arc	Arc	Arc	A	A
" (Mod. C)			A	Arc	A	Arc	A	Arc	A	A
" (2 & 3½ ton)	A	A								
Detroiter	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
Dodge Brothers	A	Arc	A	Arc	A	Arc	E	E		
Dort	A	Arc	A	Arc	A	Arc	A	Arc		
Empire (4 cyl)	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Federal	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-X)	A	A	A	A						
" (Special)	Arc	Arc								
Fiat	B	A	B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Hal-Twelve			A	A	A	A				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
Hellier (6 cyl)	A	Arc	A	Arc						
" (8 cyl)	A	A	A	A	A	A	A	A		
Hudson					Arc	Arc	Arc	Arc	Arc	Arc
" (Super Six)	A	Arc	A	Arc	A	A				
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Jordan	Arc	Arc	Arc	Arc						
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King							A	Arc	A	A
" (8 cyl)	A	A	A	A	A	A	Arc	Arc		
" (Cont'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Mod. 48)					A	A	A	A	A	A
" " (12 cyl)	A	A	A	A						
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Liberty (Detroit)	Arc	Arc	Arc	Arc						
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)			A	Arc	A	Arc				
" " (Mod. MW)			A	Arc						
Locomobile	A	E	E	E	E	E	E	E	E	E
McFarlan	A	Arc	A	Arc	A	A	A	Arc	A	A
Madison	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A	A	A				
Marmon	A	A	A	A	A	A	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	Arc	A	Arc
" (22-76)							Arc	Arc		
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (6 cyl)					A	A				
Moline-Knight	B	A	A	A	A	A	A	A	A	A
National	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	A
" (12 cyl)	A	A	A	A	A	A				
Oakland	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A				
Oldsmobile	A	A			Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	A	A	A	A	A	A				
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc	A	Arc		
" (Mod. M22)	Arc	Arc	Arc	Arc						
Packard							A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
" (Cont'l)	A	A	A	A	A	A	A	A	Arc	Arc
Paige (4 cyl)							A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
" (6-36)					A	Arc	A	Arc		
" (6-36-39)			A	Arc						
" (6-40)	A	Arc								
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Pathfinder			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl)			A	A	A	A				
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Pierce Arrow	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " (Cont'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	Arc	A	Arc	A	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	Arc	Arc		
Renault (Fawnch)					A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	E	E						
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (3½ ton)			A	Arc						
Simplex					A	A	A	Arc	Arc	Arc
Stearns-Knight	B	A	A	A	B	A	B	A	B	A
" (8 cyl)	B	A	A	A	B	A				
Studebaker	A	Arc	A	Arc	A	Arc	Arc	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl)							A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc								
" (½ ton)	A	Arc								
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (16 valve)	A	A	A	A						
Willys-Knight	B	A	A	A	B	A	B	A	A	A
Willys Six	Arc	Arc	Arc	Arc						
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Electric Vehicles:—For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential, use Gargoyle Mobiloil "C" the year 'round.

Exception—for ***winter lubrication*** of pleasure cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

The Current Supplement

BEFORE the art of working metals was discovered primitive people in all parts of the world formed their implements such as knives, arrow and spear heads of hard stone, and the question is often asked, how people who possessed no tools of any kind were able to produce such accurately formed instruments from such stubborn materials. An article on *The Stone Age in America* tells how this was done, and the methods employed by the Indians from prehistoric times down to a recent period. A number of photographs and drawings fully illustrate the process. *The Age and Area Law* deals with the geographical distribution of trees, plants and shrubs throughout the world. *The Break-Down of Our Railway Transportation* gives one of the main reasons why, with our supposedly magnificent system of railroads, we are suffering so much inconvenience from fuel shortage and restrictions and delays in every branch of transportation. A number of excellent illustrations accompany the article. The fourth lecture on *Problems of Atomic Structure* appears in this issue. *The Properties of Oils* is an important paper dealing with the subject of lubrication, and is illustrated by several diagrams. *The Geology of West Africa* contains a large amount of information in relation to a little known region, together with notes on its resources and possible future development. Other articles of interest in this issue include *Hydroelectric Development*, which throws much light on an important resource of our country; *The Nature and Treatment of Wound Shock; A Permanent Electric Cell* and *Salt Water Aquaria in the Home.*

Suggestion to Develop Niagara Falls' Full Efficiency

(*Concluded from page 495*)

be used at full efficiency. The advantages, direct and incidental, of damming Niagara River above the Falls and constructing a joint hydroelectric power development on the Canadian side of the river by the Government of the United States and Canada are as follows:

Maximum efficiency.

Economy in construction.

Economy of operation and a big reserve of power available for either country.

Another bridge across the river.

Niagara Falls, New York, and Niagara Falls, Ontario, would become lake ports, and all industries located on each side of the river could receive raw products and ship finished articles direct by boat; which means new industries.

If a deep-water level is maintained, so that the boats can always load to their water line, $10,000,000 will be saved, annually, by the steamers which use Lake Erie.

There will be no more anchor ice, or frazil, to interfere with the operation of the power plants; also no further danger of ice jams in the river.

The crest of the Falls can be strengthened during the periods when the water is shut off, and the breaking down of the crest can be arrested.

Such a development, with its successive extensions, would provide work for thousands of returned soldiers for several years after the war.

It would mean cheap light, cheap heat and cheap power.

The Assuan Dam was built across the Nile, the Keokuk Dam across the Mississippi—why not the International Dam across the Upper Niagara?

Let every person who desires cheap light, heat and power ask the Government to push this scheme through as a War Measure, as a Peace Measure, as a business proposition and as a National investment, and to arrange with the Government of Canada that the United States Government shall join with the Hydro-Electric Power Commission of Ontario and increase their 250,000 horse-power development, now under construction, to 500,000 horse-power. Surveys and plans should be completed as soon as possible, so that work can be started on the International Dam just as soon as "the boys" are released from the war to do the work.

Saving Fuel in Street-Car Operation By the "Skip Stop"

CUSTOM is responsible for many things in electric railway operation. It is custom that stops a street car at every corner, no matter what the distance may be between corners; it is custom that sets the same opening and closing hour for every industrial establishment and place of business and so makes the rush-hour problem. It is custom and the demand of real estate promoters that insists on excessive service for little traveled lines.

And it costs money to start and stop an electric car; it costs money to provide equipment and power and labor for rush-hour travel, and it costs money to furnish unnecessary service.

The National Research Council of the United States Government estimates that one-sixteenth of the fuel used by electric railways of the United States can be saved by the inauguration of what is known as the "skip stop," that is to say, stopping the cars at intervals of 600 feet instead of at every corner as at the present time. It also produces other substantial economies. The "skip stop" insures the speeding up of schedules and reduces the time of the journey.

The only inconvenience it causes is to a small part of the public compelled to walk a few feet farther.

The so-called "staggered" hours of business as applied in Buffalo, Seattle, Rochester, Detroit and other cities of the country, means no longer hours of labor for any one, but does mean less crowding and less discomfort. Under this plan the hours of business in certain districts are advanced or retarded from ten minutes to an hour, so that instead of all workers in every district beginning and stopping work at the same hour, their time for beginning and quitting is distributed over a longer period. In Rochester, where the "staggered" hour plan was put into effect under the auspices of the Chamber of Commerce, a material saving in equipment has been effected and the comfort of the car-riding public materially enhanced.

Coöperation of the public authorities in matters of operation will further reduce operating costs. The problem of traffic regulation is vital to operation. The application of the doctrine of the greatest good to the greatest number would give to street railways the right of way in public thoroughfares—consideration of the convenience and comfort of the car-rider would dictate that tracks be kept open for them. This, concludes *Area*, would result in increase of schedule speed and a corresponding reduction in expense.

Resignations of Patent Examiners Not Accepted

SO many vacancies in the Examining Corps have been created through resignations of members entering the military service or going out into commercial employment, that the Commissioner of Patents has been constrained to refuse acceptance of resignations incurred through the latter motive. The tendency for technical and manufacturing establishments to engage expert patent men to assist in the development and protection of their inventions is a constantly growing one. As the main source of supply for these experts is the Examining Corps of the Patent Office, and as the pecuniary inducements presented are substantially greater than the government offers, it requires the most drastic measures to prevent the consequent depletion of the corps to the point of crippling the office. Not only is it essential to utilize this Draconian measure to prevent the disappearance of a substantial fraction of the personnel, but unusual efforts to engage men for the vacancies already existing have also been resorted to. A Macedonian cry for help has been issued at various times by the authorities urging qualified men to enter the service, the appeals being addressed not only to those who would have to enter by passing a civil service examination, but also to those former employees of the office who are now engaged in profitable, private practice.

The Longest Possible Bridge Spans

(Concluded from page 505)

fifty million people per year now crossing the Bay, is estimated to reach upwards of sixty million by the time a bridge can be completed, and would be distributed up and down Market Street in San Francisco on a double track elevated loop. Connection would be made in Oakland with all the rapid transit lines, and the time from the homes to offices would be reduced from one third to one-half the present time for a Trans-Bay trip.

The bridge would be coördinated with a comprehensive enlargement of the Harbor facilities of Greater San Francisco, which would prove a vital factor in the control by this country of the commerce of the Pacific and the trade of the Orient. Thus would a truly monumental structure become an important link in the harbor and rapid transit systems; but the bridge with its four towers 450 feet in height, its great spans of 2,000 feet having massive steel octagonal members 14 feet in diameter, would mark an epoch in bridge engineering.

While engineers have determined that arch spans could be economically constructed much longer than the 1,000 foot Hell Gate span, that suspension spans could now be built up to 4,700 feet span and cantilevers up to 2,700 feet span, we may consider that the 3,100 feet span for New York and the 2,000 feet spans at San Francisco represent the greatest spans that will likely ever be built. This will be due to the growing scarcity of raw materials, which will result in a greater cost of steel, even under normal world conditions, which will make the construction of very long spans economically impossible within at least, the next generation.

The growing tendency to more artistic bridges should be noted, as both the design of the great 3,100 feet suspension span for the crossing of the Hudson, a type inherently beautiful, and the design of the 2,000 feet cantilever spans for San Francisco, a type of extreme utility, have been worked out in very pleasing manner. The endeavor of the bridge engineer to design structures of artistic merit, even though true architecture is impossible, is evident in so many of our recent designs and structures, as to make more noticeable those cases where no effort has been made in this direction. There are very few structures where economy and beauty need be considered as opposed one to the other.

The Heavens in June

(Concluded from page 506)

but a single star, there would be nothing to use as a standard to indicate whether it had been shifted or not.

During the coming eclipse, unfortunately, the sun is in a field poor in stars; and it is not certain whether a definite answer to the question can be obtained. But next year there will be a total eclipse of longer duration, with the sun in a very favorable region; and if only the weather in Brazil and along the African coast is good, and if the conditions of the war permit the departure of scientific expeditions, the problem should be solved.

The Heavens

Turning from the rare and fleeting phenomena of the eclipse to the eternal stars, we find our familiar friends at their stations, as our map shows. Scorpio and Sagittarius are in the south, Ophiuchus and Serpens above them, Hercules, Corona and Boötes nearly overhead, Cygnus, Lyra and Aquila in the east, Cepheus and Cassiopeia in the northwest, Ursa Minor and Draco in the north, Ursa Major in the northwest, and Leo and Virgo in the west.

The Planets

Mercury is a morning star when June begins, rising about 4:45 A. M. (by the present legal time, an hour fast of astronomical mean time.) He is south of the sun, and not conspicuous. Later in the month he becomes lost in the dawn, and on the 27th, he passes through superior conjunction and becomes an evening star.

Venus, too, is a morning star, rising between 3:20 and 3:40 A. M. throughout the month, and being very bright. Mars is an evening star in Leo, and is in quadrature with the sun on the 20th. At this time he is almost exactly on the celestial equator, so that he sets at midnight in reality, though for the present we call it 1 A. M.

Jupiter is in conjunction with the sun on the 15th, and invisible, except during the darkness of the total eclipse. Saturn is in Cancer, and is an evening star, setting at 11.30 P. M., clock time, in the middle of the month. Uranus is in Aquarius, and comes to the meridian about 5 A. M. Neptune is in Cancer, about six degrees west of Saturn, and too low for good telescopic observation.

At the time of the total eclipse, Jupiter will be about 5 degrees east of the sun, and very conspicuous. Mercury will be some 20 degrees west of the sun, and as bright as Arcturus, but pretty low for American observers. Venus, 40 degrees west of the sun, will have already set. Saturn, nearly 60 degrees east of the sun, and Mars, more than 90 degrees in the same direction, should be easily seen.

The moon is in her last quarter at midnight on the 1st, new at 6 P. M. on the 8th (the time of the eclipse), in her first quarter at 9 A. M. on the 16th, full at 7 A. M. on the 24th, and in her first quarter again on July 1st, at 5 A. M. She is nearest the earth on the 5th, farthest away on the 17th, and nearest again on the 30th. As she circles the heavens she passes near Venus on the 5th, Mercury on the 7th, Jupiter on the 8th, Neptune and Saturn on the 12th, Mars on the 16th, and Uranus on the 28th.

On the morning of the 24th there is a small partial eclipse of the moon, less than one-seventh of the diameter being obscured, on the southern limb. She first enters the earth's true shadow at 5:46 A. M., eastern standard time, is eclipsed to the greatest degree at 6:23, and leaves the shadow at 7:10. As the moon sets, and the sun rises, at about 5:40 A. M., allowing for the present adjustment of our clocks, it appears that very little of this eclipse will be seen in the eastern United States, but that it will be well visible in the western part of the country.

In Camp, Texas, May 12, 1918.

Cooperation of Employers and Employed in Great Britain

IN this important matter things are moving steadily. In November, 1917, Mr. F. Huth Jackson presided over a representative meeting of the National Alliance of Employers and Employed held at the Caxton Hall. The constitution and the machinery (the main features of which are the central council, the executive council, and district committees, which should be composed of employers and representatives of labor in equal numbers) was decided upon and a program setting forth the broad aims of the Alliance adopted.

The objects of the Alliance are (1) to promote active coöperation of employers and employed in the treatment of questions generally affecting labor and employment in all trades and industrial occupations, (2) to promote the welfare of the industrial workers of the country and the efficiency of its industries (3) to promote arrangements for facilitating the reinstatement in civil employment at the end of the war of men serving with the forces and of munition workers. The Alliance will not, unless especially requested to do so, interfere with arrangements existing between employers' associations and trade unions for the settlement of questions affecting wages, hours, and conditions of labor.

Mr. Huth Jackson made a statement relative to the advisory committees which are to be attached to the employment exchanges in connections with the demobilization scheme as prepared by the Ministry of Labor. Some of the members of the Alliance, he said, had hesitated to recommend their friends to join these advisory committees because they were unable to find out whether their duties were to be purely advisory or whether they were to have some executive or administrative functions. The Minister of Labor

had authorized him to announce that the committees were to have certain definite administrative functions in regard to demobilization. That would make a great difference in the attitude of a number of employers and workmen. In regard to the Whitley committee's report, adopted by the Government, he said that Mr. G. H. Roberts had declared that it was the intention of the government to appoint a parliamentary committee, of which Mr. Whitley would be the chairman, which would consist of three members from each party in the House of Commons, and which in consultation with the National Alliance, the Industrial League, and other similar bodies, would consider the best means by which the recommendations of the Whitley report should be carried into effect.

The Whitley committee, which has already done most excellent work in suggesting measures for bringing employers and employed together, has now issued a new report dealing specially with its proposal for the creation of what are called works committees. The proposal is that joint committees of employers and employed should be set up in each factory, workshop or coalpit, and the point of the report now issued is to lay stress both upon the functions and upon the limitations of these committees. Works committees are not intended to deal with such subjects as rates of pay and hours of work, because these must almost of necessity be uniform over large districts, and in some cases over the whole kingdom. But apart from such questions, which have finally to be settled between federations of employers and great national trade unions, there are a multitude of detailed questions peculiar to each individual workshop or factory. It is to settle these that works committees are required. They may also be of great service in developing in each workshop the constructive ability of the workpeople themselves—a quality which is too frequently ignored both by individual employers and by paid managers.

Very properly the Whitley committee expresses a hope that no attempt will be made to set up works committees without the concurrence of the trade unions. It would, indeed, be fatal to all schemes for the peaceful reconstruction of any industrial organization if plans were launched which implied that the existence of trade unions might be ignored! There is good reason to believe that the majority of trade unions will welcome the establishment of works committees; for the present attitude of workpeople to employers is distinctly more friendly than it was before the war, largely because both employers and employed have suffered so bitterly from the irritating, and frequently ignorant, interference of government officials.

The Union Ticket Office

OF the changes which Federal control has brought or will bring about in the railroads' ways of doing business, few will touch the general public more directly than the one with reference to the selling of tickets and other service. At present we can buy tickets not only at the stations, but at a great quantity of city ticket offices. Originally established as a necessary means of competition for passenger traffic and of convenience to the traveling public, these have now reached a point where they are a great burden to the roads and even more or less of a nuisance to the people at large.

In New York city alone there are, aside from the regular station offices at the terminals and the ferries, over fifty ticket offices scattered throughout the city. Some of these are maintained by a single line, others by several lines in concert. They are located for the better part in store properties on Broadway and Fifth avenue—the two most expensive streets in the city. They cost the roads over a million dollars per year in rentals, and far more than that in salaries and other operating expenses. And if in some respects they seem to be a public convenience, they are in other ways far from it. For while the idea is an excellent one of a ticket office in the business section of the city, eliminating as it does the necessity for making a special trip to the station to buy tickets, get Pullman accommodations, check baggage, etc., it does not always work out well in practice. In a nest of ticket offices like that of upper Broadway, it is a matter of some difficulty to find the right one, especially when most of the wrong ones can furnish the desired ticket or the desired baggage transfer, but fall down in some other essential; and having found the right one, if the trip in prospect is at all a complicated one, as often as not all the business cannot be transacted in one spot after all.

Obviously, if the railroad business were being built up new, out of whole cloth, so that we could get everything right without the distressing entanglements of habit and history and gradual developments of bygone conditions to confuse us, what we should do would be to have one great city ticket office—or more, if the size of the city justified more—in which one could do all the business incidental to going from any one place in the United States or Canada to any other. This would give all the conveniences of the idea of having a ticket office off the line, with none of its inconveniences. Why should a road running west from Chicago maintain its own exclusive ticket office in New York or Boston or Washington? Why should the roads passing out of Washington to the south have their own establishments in New York, independent of those of the Pennsylvania and the Baltimore and Ohio, one of which the New Yorker must use to get to Washington? Apparently for no other reason than to compel the passenger who purchases his ticket through to his destination at the Pennsylvania Terminal to run over to Fifth avenue for his reservation.

The change which has been ordered for all cities, and which has gone into effect in at least one (Washington) consists in the consolidation of the city ticket offices into one or more union ticket offices, according to local conditions. In New York it is understood that there will be four or five of these, one in each of the big civic centers like "downtown" and "Harlem." In Washington there will be but one place outside the Union Depot where a person can do business with the ticket agent. But he will know just where this place is, and he will be able to go to it with full confidence that he can do all his business right there, with a single clerk. Obviously, the innovation is an excellent one, even apart from the very material saving which it will effect for the roads.

Cast Instead of Forged High Speed Steel Tools

NEARLY all of the high speed steel now used in such large quantities in the shape of tools for machining shells or any form of steel is first rolled into bars and the bars shaped into tools. A fairly new idea is the casting of such steel directly into the tool. This has been tried in the United States, but it has not been widely used. The French, however, have been quite successful on three grades of material.

The extra hard steels experimented with contained 2.7 per cent carbon, 19.4 per cent chromium, 24.9 per cent tungsten and 0.4 per cent vanadium. This alloy was cast in rectangular steel chill molds 10 mm. wide by 15 mm. deep. The top surface showed a line of piping which was found to be 5 mm. deep. It is the lower part, the part cooled the most thoroughly, which is used for the cutting edge. As cast such an alloy is feebly magnetic and very brittle; it falls to pieces while being ground. When annealed for two hours at 550 degrees C. it is much less brittle, can be ground, and at the same time is slightly more magnetic.

With a tool prepared in this way it has been found possible to turn a round piece of quenched chrome-nickel steel, with a Brinell hardness of 550, and 40 mm. diameter, for 15 minutes. The speed was 200 revolutions per minute, the depth of cut two-tenths of a millimeter. This hard alloy, brittle even after annealing, can only be used after taking the greatest precautions, and it has not been found possible

to use it continuously. If the annealing is carried out above 550 degrees C. the brittleness is greatly reduced; but the cutting qualities, at least for very hard steel, diminish rapidly.

Hard steels containing 1.2 per cent carbon, 6.6 per cent chromium, 23.0 per cent tungsten and 0.8 per cent vanadium, were also tried. This steel was cast in steel molds 20 mm. square, or in rectangular molds 20 mm. by 15 mm. The mold was horizontal and, as before, the lower part was taken for the cutting edge. After casting the tools were subjected to an annealing at 525 degrees C. for two hours which lessened the brittleness.

Such tests as have been made have shown that these tools allow greatly superior speeds to the best forged high-speed steels, but it has not been possible to push the tests to the limit as the lathes were not powerful enough. When working on the rough turning of 155 mm. shells before quenching these tools stand up, without being reground, four to ten times longer than the best forged high-speed steel. A lot of 70 shells which could not be worked at all with the forged high-speed steel were machined, after quenching, at the usual speed. This steel is, therefore, very interesting, although special precautions must be taken to guard against brittleness.

Finally a normal steel showing 0.7 per cent carbon, 3.5 per cent chromium, 19.0 per cent tungsten and 0.8 per cent vanadium was tried. On shell steel the cutting speed of these cast tools is not greatly superior to that of the forged tools. The number of grindings necessary in service were less (about one and a half times) than for the forged steel. These steels can be used as cast, and if they do not have the great hardness of the more highly carburized steels they are advantageous because of their relatively low brittleness. This grade of steel is of the readiest application at the present time. If it is found that annealing is necessary, 500 degrees C. should be used.

Under the heading of general remarks it is noted that these cast tools could not be made too large or they would not quench throughout their cross section. The greatest care should be taken to have a good surface on the cast steel, so that grinding can be reduced to the minimum. For the best results the surface of the steel should be scarcely whitened with the wheel. Manganese is very harmful, and 0.5 per cent is enough to spoil the tool.

It would seem that these cast steels will certainly find a place in modern practice. That have not yet been sufficiently studied, however, to determine the best composition, shape of cutting edge, etc. At present only those are used which approach in quality the forged steels and which can accordingly be easily adapted to present drop practice.

Occupational Diseases

THIS subject is interesting and important as well as full of surprises. Housemaid's knee, for instance, which for many years has served as a subject for humorous comment, proves to be a frequent malady of miners. The statistician is abroad in this and other lands and he brings the information that trades carried on in the presence of much dust show a high death rate from diseases of the lungs. Then comes the biologist who explains that dust is not only minute particles, but that the particles are usually surrounded by a watery envelope, and that clinging to this filament there may be micro-organisms.

The medical authorities abroad declare that soot is a serious irritant and that chimney-sweeps are especially subject to cancer because of it. Sawing certain kinds of wood has been found to produce irritation of the mucous membrane of the nose, throat and eyes. The makers of white lead have looked lead poisoning square in the face and have found means to avoid it. Dr. Patterson of Philadelphia devised an entirely reasonable but somewhat unexpected treatment for it. He immerses the patient's hands in one tub of salt water and his feet in another, and then a pole of an electric battery is put into each of the tubs. The current is turned on, using Mr. Patient as a conductor, and it carries the lead that it finds on the way, out of him, through the salt solution, depositing it upon one of the electrodes. This procedure has proved successful.

Fatigue is another subject that has been studied and reported on. Strain is declared to be more exhausting than work, and monotony of employment aggravates exhaustion. Fatigue seems to be a condition of the body in which the waste products of work are not carried off fast enough. In physiological laboratories animals have been fatigued by over-driving and then some of their blood has been injected into the veins of healthy animals. The healthy animals straightway showed the same symptoms of fatigue as those that had been over-worked.

In rubber factories and elsewhere, when bi-sulphate of carbon is used, great care must be taken to avoid contamination of the air by its offensive fumes. Otherwise nervous troubles are likely to follow.

There is a baker's itch, grocer's itch and sugar refiners' itch, all manifestations of eczema, according to the materials handled.

The question is likely to be asked why boards of health do not use chlorinated water for flushing the streets, especially in hot, dry weather. This was first proposed by Dr. Baskerville six or seven years ago, and there is no question but that its effect upon disease germs in the street dust would be beneficial to the public health. Since the New York water supply has been treated with chlorine, not a single case of typhoid fever has been traced to it as the cause. It is doubtful if any other satisfactory answer will be forthcoming than that the boards of health haven't got around to it yet.

How the House Fly Spends the Winter

THE U. S. Bureau of Entomology has recently investigated this subject with considerable pains; and while the conclusions are to a certain extent purely negative, it is established that the fly may winter in either of two ways. There may be continual breeding throughout the winter in warm places where both food and refuse material for oviposition are available; or survival from season to season may be in the larval and pupal stages, in or under large manure heaps. There is no evidence to show that the house fly can or does persist as an adult from November to April, either outdoors, in protected stables, in attics, or in heated buildings. Temperatures of twelve and fifteen degrees Fahrenheit are quickly fatal, and there is reason to believe that anything below freezing is fatal if continued long enough. But individual longevity is not adequate to reaching over the winter in any event. If flies find access in the autumn to heated buildings where both food and media for deposition are available, such as animal houses or restaurants in which attention is not given to the disposal of kitchen and garbage wastes, they will continue breeding throughout the winter. In such cases the flies present in March and April are the descendants, not the survivors, of those which found their way to the place the preceding fall. It is suggested that this method of overwintering is far more widespread than is realized, especially in cities where the hordes of flies that appear late in May indicate the presence of several such foci. Which method of over wintering is the more common cannot be definitely stated; but it appears certain that only a small percentage of the larvæ which are present in manure heaps in the autumn live through the winter and give rise to adults in the spring. Of course, in no other surroundings would such survival be possible at all, on grounds of temperature.

Mining and Metallurgical Terms

A GLOSSARY of Mining and Metallurgical Terms is in course of preparation in the U. S. Bureau of Mines. The material includes about 25,000 terms used in the various branches of mining, quarrying and metallurgy, together with many chemical terms relating to metallurgy, and about 2,000 Spanish-American mining terms.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14283) A. M. G. asks: How long each sign of the Zodiac is in effect at a period? Almanacs show the signs for two or three days which we understand to mean the larger part of such days are subject to the sign shown. We wish to know how many hours and minutes there are to a period and if the periods are uniform length. A. The signs of the zodiac are one-twelfth of a circumference long, or 30 degrees. The sun enters Aries this year on March 21st at 5 hr. 26 minutes A. M. He enters Cancer June 22d at 1 hr. 6 min. A. M. These and other times may be found in Almanacs. These periods are not of uniform length since the earth does not move around the sun with a uniform motion.

(14284) E. J. C. asks: In the plant at which I am employed there has arisen a great controversey as to the answer to the following question: 1÷0=? or, stated in words, what does one divided by zero equal. Some of the boys (myself included), say that zero will go into one an infinite number of times while others claim that 1÷0=1 and still others say that 1÷0=0. In the end all agreed to accept the SCIENTIFIC AMERICAN as authority and I am writing this to request that you settle this point for us. The whole operating force of a large power plant is involved in this argument. Inclosed please find stamp for reply which I assure you will be very much appreciated. A. You are quite right in saying that 1÷0 gives infinity for a quotient. you can demonstrate this result in this way:

1 divided by 1 equals 1
1 divided by .1 equals 10
1 divided by .01 equals 100
1 divided by .001 equals 1000
1 divided by .0001 equals 10000

The smaller the divisor the larger, etc. to any extent, the quotient becomes in the same ratio. Therefore if the divisor be reduced to zero the quotient will become larger than can be imagined or infinity. 1 divided by 1 is 1, and 0 divided by 1 is zero. So too is zero divided by any other number, as 0 divided by 5. If 5 heirs have nothing to divided among them each share will be zero.

(14285) P. W. B. asks: Today at 3.35 P. M. while sitting on my front porch there suddently began a marked tremor of the earth, and a shaking of the doors and windows of the house, and a very strong feeling that the porch was raising and lowering. Likewise when I looked at the street I received a very strong impression that the surface of the street and yard was rocking and rolling, much the same as the rolling on a vessel in a swell. The tremor continued it seemed about two minutes increasing in strength for some time, gradually dying out. I did not take much stock in the effect upon me of the surface of the street, yard, porch and general surroundings as having actually rolled, though my eyes seemed positive as to that being the case. A. No doubt the surface of the earth moved as you saw it move in the earthquake tremors which you describe. The seismograph is an instrument for writing down the horizontal movements of the surface of the earth in earthquakes. There are many of these instruments in different parts of the world especially in regions where the earth's surface is not very quiet. Probably the tremors which you felt were recorded upon a seismograph in some place on the Pacific Coast. It is also probable that your excited senses caused you to magnify the motions of the earth. They may not have been so large as you thought them to be.

(14286) S. O. asks: Can you tell me something about cooling by evaporation? I understand that if an earthen crock, filled with water, is exposed to the sun, it will keep cool through some process of evaporation. What I really want to know is this: If I build a skeleton box and cover it on all sides with a cotton cloth, if these cloth sides are always kept saturated with water, will the inside of this box be appreciably cooler than what the outside temperature is? This box is, of course, to be placed outside and exposed to the sun. A. A porous earthernware vessel without glazing will keep cool if filled with water and exposed to the sun, but it will not become as cold as if hung up in a place sheltered from the sun and exposed to the wind. In the torrid zone water is cooled in this way for drinking. The vessel is hung under a veranda, or where the air blows over it to carry away the water vapor as it forms, and the water is cooled. The vessel must be porous so so that water will pass through the walls and be evaporated from the outside to cool the water in the vessel. In the arrangement which you propose you will do better to use several layers of cloth on the box in order to have as much water exposed as you can, and place the box in the shade rather than to expose it to the heat of the sun. Under a tree hung from the branches and swinging in the air would be a good way to fix it. People sometimes wrap a glass bottle in a wet towel and hang it in the wind to cool the contents. This is similar to what you propose.

The True Story of the Liberty Motor

(Concluded from page 500)

number of very important features, it has been necessary to revert to the original design.

Production of the Liberty Motor is now proceeding at a very satisfactory pace. More motors are being produced than there are planes to carry them. When the writer visited the Packard plant several weeks ago they were being turned out at the rate of 15 per day and it was hoped that inside of two months a production of 50 per day would be attained. No expense was being spared to reach this rate of production, but again the matter of organization was holding up the work so that it was considered impossible to attain that rate before the end of June.

In the Ford plant, manufacture of the Liberty Motor was just about to start with a program of 100 complete engines per day when the plant is in full operation. Here, as in the Packard plant, the standard equipment of the machine shop was being overhauled and reorganized for work on the Liberty Motor. This was being done at the expense of the regular commercial motor. In several other factories work on the Liberty Motor has either just begun or is about to begin, and certainly by the middle of the summer the Liberty Motor ought to be produced in very large quantities. The only thing that is retarding the airplane program now, is the manufacture of planes to carry the motors.

The efficiency of the Liberty Motor is not to be questioned by anyone who has examined it thoroughly. It is far more powerful than any other airplane engine ever produced on a quantity production basis. It exceeds in power all but a few experimental machines. Although rated at 400 horse-power it has shown on test as high as 485 horse-power; and its weight is 820 pounds.

It is a mistake to assume that any one motor is adapted to all classes of airplane service. There is no single motor abroad which is of such universal utility. The Liberty Motor is one of the most powerful airplane motors in the world, and the lightest for its power. Obviously, it would be impracticable to use it on light machines which do not require such power, or on slow observation machines. But it is ideal for bombing purposes, for here we have large airplanes of great carrying capacity that must travel long distances at high speed. The Liberty Motor should also be available for fighting machines of the larger types. We are making a great many motors of other types for our training machines and for our lighter fighting machines. Altogether, the airplane situation is fast approaching a very satisfactory basis, and before the end of the year it should play an important part in the great struggle on the other side of the water.

Peanut Flour

THE Southern States have long been familiar with the use of crushed or ground peanuts in breads, muffins and biscuits. This has always meant a saving of wheat and should continue wherever the flour made by grinding the press-cake is not available. The advantage of using either the flour made by grinding whole peanuts or the flour made by grinding the cake remaining after expressing the peanut oil, is that fat is saved as well as wheat, and it is also a patriotic duty to save fat. The saving of fat when the peanut oil is used comes in two ways: first, the peanut oil which has been pressed out of the peanut can be used for other purposes, and, second, since all of the oil is not removed in pressing, that left in the peanut flour makes it possible to use less fat than the recipes ordinarily demand.

"Peanut flour unmixed can be substituted for wheat flour in cooking, but it has more protein than wheat flour, so any combination with rice, cornmeal, or corn flour is desirable, as they add the starch which is lacking in the peanut flour.

The United States Department of Agriculture has just issued Circular No. 110 giving many peanut flour recipes.

Moving a House After Cutting It In Two

IT is nothing unusual to move a house, but it is quite extraordinary to cut it in two, move it and then re-unite it. This was recently done in West Somerville, Mass., where a large three-story dwelling was cut in two, moved from an eminence 10 feet above the street level and set up a mile distant from its former resting place. It was found impossible to move the house in its entirety, because of the narrow "holes" through which it was to be taken. As each of the sections was 35 by 20 feet at the base and almost 40 feet in height, they were liable to topple over during the process of moving. This was prevented by tearing down the chimneys and foundations and loading the first floor of each section to a considerable depth with brick. This acted as a ballast and the sections were moved without any damage to the structure.

Preserving the Natural Green of Plants

A DISCOVERY of very great interest to botanists and others, has recently been made. As is well known when plants have been dried by any of the well known processes (such as under pressure, in hot sand, or by sulfur fumes) the foliage loses most of its natural greenness. To get anything resembling a life-like effect, the leaves have had to be artificially colored and this plan has not proved to be very satisfactory. The difficulty has been entirely surmounted owing to the fact that it has been found possible to form a chemical compound with the chlorophyll which is permanent. The method adopted is on the following lines. A boiling solution of copper acetate and acetic acid is prepared. Into this the parts of the plants to be preserved are steeped. The acetate combines with the chlorophyll and forms a permanent coloring matter. Whatever the original shade of green may be this color is perfectly fixed. The drying process can then be carried forward. Where the particular method is that which preserves the form, as is the case when hot sand is used, the preserved plant is wonderfully life-like. The steeping in the copper acetate appears to have no effect on the flowers. If the drying is carried out with sand or sulfur fumes the original hues are usually well preserved.

The plan described above has also been employed in the preservation of seaweeds with excellent results. For the brown seaweeds it has been found needful to add a little permanganate of potash to secure the best effect. With the red seaweeds certain stains are used but, when once the right color is secured, the copper acetate fixes it for all time. One great value of this plan is that the plants so treated do not suffer from exposure to light. After some months of standing in direct sunlight the treated specimens were as bright green as if they had just been freshly gathered.

A Lost Antarctic Parrot

WHEN Macquarrie Island, situated in latitude 55° S., 600 miles to the south of New Zealand, was discovered in 1810 it was inhabited by a peculiar flightless parrot described by a contemporary who saw numbers of the birds which were brought to Sydney by sealers as "the glibbest of the loquacious tribe." Recent investigation of the island makes it almost certain that this strangely isolated specimen of the parrot family is completely extinct, probably as a result of the introduction of cats which have become wild and overrun the island.

The Appendix in Animals

THE Australian wombat, a marsupial, shares with man and some of the higher apes the distinction of being the only animal to possess a vermiform appendix. Curiously enough the appendix has in this animal of a very ancient type made further progress towards elimination than it has in man. In a collection of specimens of the appendix of the wombat made by Dr. W. C. Mackenzie of Melbourne, the appendix can be seen degenerating till it almost reaches the vanishing point.

NEW BOOKS, ETC.

THEORIES OF ENERGY: By Horace Perry. New York and London: G. P. Putnam's Sons, 1918. 8vo.; 238 pp.; illustrated. Price, $1.75 net.

The author's twenty-years' study of this fascinating but elusive subject has led him into many branches of science, and his hypothesis that all atomic matter is perpetually energetic within itself and that the energetic condition of each part is affected by the energy of other parts certainly results in theories that supply us with much food for thought. The virginity of this field of investigation is demonstrated by the fact that the author has been forced to invent many new terms of expression in order to get his ideas explicitly and concisely before the reader; in this rather difficult task he has used excellent judgment, so that, the meaning of a term once grasped, it is not forgotten. Each chapter takes up a theory; each theory deals with a particular problem—energial propagation, the spectral lines, chemical reaction, gravity, or edgetal deflection, as the case may be, and simple, interesting experiments brighten the text.

A SHORT HISTORY OF FRANCE. By Victor Duruy. New York: E. P. Dutton and Co. 12mo.; 100 pp. Two volumes, each, cloth, 60 cents; leather, $1.25 net.

The historical section of "Everyman's Library" is notably reinforced by this popular work. Duruy resolved to devote his life to the writing of a history of France; as he dug into old Gallic soil he came upon Roman foundations; properly to understand these meant a journey to Rome; there Greek influences were so apparent that they forced an exploration of Athens. Such were the thorough foundations of Duruy's knowledge, and the result fully justified the labor. An appendix by Lucy Menzies carries on the narrative through the Franco-Prussian war to the craftily planned coup of the modern Huns in 1914.

POWDERED COAL AS A FUEL. By C. F. Herington, M.E. New York: D. Van Nostrand Company, 1918. 8vo.; 222 pp.; illustrated. Price, $3 net.

Powdered coal, properly used, has great advantages over the raw coal and produces a smokeless fire, strong, steady heat, and a high furnace temperature. Compared with fuel oil and natural gas, its price fluctuations are moderate. Mr. Herington, after long experience as assistant engineer with one of our leading railroads, with unusual opportunities for accurate observation, gives us comparative costs of installation and operation, considers the coals suitable for pulverizing and the modes of preparation, feeding and burning, with the application of these methods to specific purposes and industries. The danger of explosions, which has beyond doubt been exaggerated, is minimized by close attention to cleanliness and change of air. A great variety of patents, designs and systems are described and illustrated by the author, and their respective uses and merits are plainly brought out in the text.

AMERICA AND THE GREAT WAR FOR HUMANITY AND FREEDOM. By Willis Fletcher Johnson, A.M., L.H.D. Philadelphia: The John C. Winston Company, 8vo.; 352 pp.; illustrated. Price, $1.50 net.

This is an account of the entry of America into the world war. It includes an examination of the policies and aims of the chief belligerents, with a review of the beginning and waging of the conflict that makes clear the imperative duty and necessity of our taking part in it. The resources and military powers of the nations engaged are inventoried, and there are chapters on women and war work, army and navy organization, universal military service, and the Monroe Doctrine. Prof. Johnson, who is an authority on America's foreign relations, has here given the general reader a book that is both informative and inspiring. In its physical magnitude, in its involvement of the entire civilized world, and in its sharply-defined alinement of all that is evil in human nature against all that makes for free civilization and peaceful development, this conflict is unique in the history of mankind, and as such we recognize it after possessing ourselves of the facts so admirably set forth in Prof. Johnson's exposition of causes and issues. Striking photographs, maps and drawings show the fighting tactics of land, water and air, American and foreign executives and celebrities, and the geographical features of the various fronts and the more important places.

NAVAL POWER IN THE WAR. (1914-1917.) By Lieut. Comdr. Charles Clifford Gill, United States Navy. New York: George H. Doran Company, 1918. 8vo.; 240 pp.; with maps and illustrations. Price, $1.25 net.

Addressed to both the professional and the lay reader, Lieut. Comdr. Gill's splendid chronicle of the naval grand tactics of the war and their results should achieve wide recognition. Its adoption by the Academic Board of the U. S. Naval Academy for use in the history course for midshipmen is a guarantee of its lucid style and its straight-to-the-point information. Allan Westcott, Ph.D., instructor in the Naval Academy, has contributed the maps and diagrams that so greatly enhance the value of the work. An estimate of the naval situation is followed by a summary of the opening activities; the action in Heligoland Bight, the Coronel and Falkland engagements, the Dardanelles operations, and the North Sea encounters and battles are diagramed and described; there is a chapter on submarine activities and the measures adopted to defeat them; andthe final chapter draws the general lessons of the war on the seas. An appendix contains material on the comparative strength of navies, on the Emden exploits, and on America's part in the development of naval weapons and tactics. Altogether the work is a most illuminating contribution to the literature of marine warfare—not a mere record of events, but a penetrating study of what those events mean, of the circumstances that brought them about, and of the lessons to be drawn from the past for our guidance in the future.

ADVERTISING. By E. H. Kastor. Chicago: La Salle Extension University, 1918 8vo.; 330 pp.; illustrated.

The average business man has no time for specializing in advertising, yet it is essential that he have a secure grasp of the broad features of the art. For such a man this text is an ideal presentment of underlying principles, practical facts and helpful sidelights, from effective copy and layout to ideas, plans and campaigns, and it covers merchandizing by advertising in all its aspects and intricacies, with the single aim of bringing buyer and seller together. The various personal appeals—to health and comfort, to appetite, to ambition, to economy—are made the primary considerations of specific discussions, pointed by concrete examples of the best copy. The work almost perfectly meets the demands of a textbook for the busy man, and even the expert may profit by the fund of experience and information so simply exhibited and so logically arranged.

THE SCIENCE OF MANAGEMENT. By Frederic A. Parkhurst, M.E., Organizing Engineer. Cleveland, Ohio: Case School of Applied Science, 1918. 8vo.; 212 pp. Price, $3.

"The Science of Management" is a selection of chapters from the books used in the Case course, forming a textbook that comprises a history and bibliography of the movement and that presents its fundamentals and essentials in a simple way, proceeding to departmental functions, drafting and planning room methods, the routing and control of work, and labor, costs, and estimating. Time study and bonus receive thorough attention, and plant efficiency, records and inspection, and the results obtained by correct applications of the science of management, are set forth in clearcut observations. All those interested in modern methods as applied to business and industry will find the work understandable and progressive, embodying the accepted theories and practice of the day.

JOURNALISM FOR HIGH SCHOOLS. By Charles Dillon. New York: Lloyd Adams Noble, 1918. 8vo.; 127 pp.; illustrated. Price, $1.

An ever-increasing number of state institutions are offering courses in journalism, and the high school periodical is an established institution. The author of this text carefully presents methods and rules that will start the student in the right way and enable him to avoid mistakes and the loss of valuable time. "In brief, the accepted method is presented by use of which a writer may gain respectful consideration for his product whether he be student, teacher, reporter, or man of business." Interviews, editorial writing and fiction each receive consideration, and there are sections on the law of copyright, libel laws, and newspaper history. The course is both critical and constructive, and may be mastered within the space of a school term.

EYE HAZARDS IN INDUSTRIAL OCCUPATIONS. By Gordon L. Berry. New York: National Committee for the Prevention of Blindness, 1917. 8vo.; 145 pp.; illustrated. Price, 50 cents.

There are 200,000 accidents to eyes in United States industries every year. Flying sparks, flying chips, injurious light rays and intense heat all take their toll; but in the final analysis it is the tendency of the employer or the workman to "take a chance" that must be blamed for these appalling conditions. The Field Secretary of the National Committee for the Prevention of Blindness has, in this pamphlet, compiled reports of typical cases and conditions, and common sense recommendations are made which, by slight changes in working conditions or the installment of protective devices, would result in saving many eyes and in conserving the usefulness of our manpower. Sixty-four plants representing 19 branches of industry have been carefully studied, and the results and recommendations are set forth not as a technical manual for the safety engineer but for the direct benefit of the average manufacturer or layman. The many illustrations assist in bringing out the gravity of the situation. The work of the Committee is entirely philanthropic, and its various contributions to the literature of safety are accessible treasuries of information that every interested person may command.

LEADERSHIP AND MILITARY TRAINING. By Lt. Col. Lincoln C. Andrews, U. S. A. Philadelphia and London: J. B. Lippincott Company, 1918. 12mo.; 191 pp. Price, limp cloth, $1 net; limp leather, $2 net.

The author of "Fundamentals of Military Service" now gives us a rather unusual work, in that it has nothing to say of the drill manuals or of the technic of warfare but deals entirely with the practical psychology of leadership, morale, and training. The rapid development of the qualities of leadership in the available human material of our new army is one of the most urgent problems of the day; every fifth man must be a leader; yet until Lieut. Col. Andrews stepped into the breach no work treating exclusively of the necessary qualifications had appeared. If you wish to learn how to become a good officer or non-com., how to handle men so as to inspire enthusiasm for the cause and unswerving loyalty and obedience to you as leader, then this book which has greatly helped experienced regular officers will help you. It is instinct with the spirit and the best traditions of the soldier. As Sherman put it, "A knowledge of human nature is half the art of war."

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No Law Requires an Eccentric Light

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Packard
Marmon
Doble Steam
Standard 8
Stutz
Daniels 8
Cunningham
McFarlan
Anderson
White
Case
Westcott
Hal Twelve
Ohio Electric
Peerless
Rock Falls
Fiat
Murray
Crawford
Lenox
Davis
Moon
Motor Trucks
Vim

REMEMBER that. If you use a glare-light you must dim it. Or you must throw the glare-rays down. But there are no restrictions on the glareless flood-light which the Warner-Lenz supplies.

That has been decided by countless authorities. The Warner-Lenz is legal everywhere. It has been accepted by every commission appointed under any State law.

Not a Compromise

The Warner-Lenz is not merely a law-escaper. It was invented before No-Glare laws were common. Hundreds of thousands adopted it before their laws required it:

Its main purpose was to do away with narrow, shifting shaft-lights. To light a wide-spread scene, and light it clearly, rather than overlight a strip.

Get these all-important features, as well as glareless light, when you change to lawful lenses.

The Warner-Lenz has these advantages:

It showers with light one's entire field of vision, just as day does. It lights the roadsides and the ditches. It lights the curves and turns, the upgrades and the downgrades.

It lights the road signs, which are often high. There are no direct beams, no glare rays; so Warner-Lenz light is exempt from 42-inch restrictions.

Turning of the lens in the lamp-rim does not affect this light. Nor does rise and fall of the car. Nor does a lamp-bulb jarred out of focus. This is of vital importance.

The Engineer's View

If you once compare the Warner-Lenz with others—in actual night use—you'll adopt it. If you can't do that, accept the verdict of those who do compare.

Note how many engineers have chosen Warner-Lenz in this way for their famous cars. Their requirements are far-reaching, and their tests exact. Get the lenses they select for cars selling from $1,000 to $5,000 each.

Glare-lights are illegal almost everywhere today — also inexcusable. Dimmers are a nuisance, and they quell the light. Shaft-lights leave unlighted most that you need to see.

Change today to the Warner-Lenz. Every hour of night driving will amply repay you. Don't defy both law and reason with a light that's out-of-date.

See your dealer or write to us. Look for the name Warner-Lenz on the edge.

Warner-Lenz Prices:

$3.50 to $5.00 Per Pair

West of Rockies
25c Per Pair Extra
Canadian Prices, $4.50 to $6.50

WARNER-LENZ

This is A. P. Warner, of the Warner Auto-Meter Fame, and inventor of the Magnetic Speedometer

THE WARNER-LENZ COMPANY, 953 S. Michigan Avenue, Chicago

(285)

MARMON
34

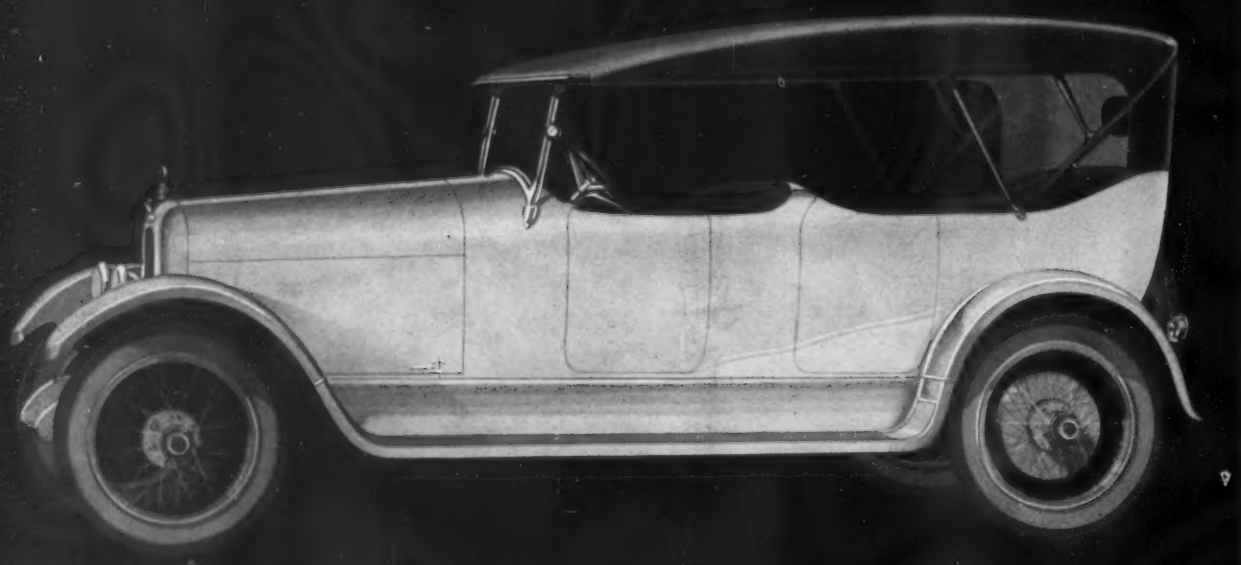
Advanced Engineering

The Stabilized Design that has stabilized the buyer's investment. The same today as when introduced over two years ago, except for wider seats, deeper sides, and other logical refinements. "Such frames as the Marmon," says one leading motor journal, "are typical of the future."

136-Inch Wheelbase
1100 Pounds Lighter

NORDYKE & MARMON COMPANY

Established 1851 Indianapolis



SCIENTIFIC AMERICAN

BOY SCOUT BUGLER GIVING WARNING OF AN AIR RAID ON LONDON [See page 521]

June 8, 1918

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

PRINCE ALBERT

the national joy smoke

swings such a peck-of-pleasure into the day's work and the night's content that you can't any more afford to be without it than you could profitably auction off your left arm! Turn a trick in your own favor before the clock strikes! Make P. A. your little old pal; play the smoke game with both hands!

Ring-in on P. A. if your smokeappetite is howling-hungry for quality tobacco!

Make a break for some Prince Albert and plug-the-gap-that-gets-your-smokegoat! For, it's highgear happiness and content that P. A. certainly will pass your way! And, you'll take such a shine to its refreshing flavor, and fragrance, and coolness!

Gee, how Prince Albert does listen in a pipe or home rolled cigarette these spicy spring days! And, *P.A.'s so satisfying!* Hooks-a-hold right into the high top notch of your keenest smokeneeds—and nails down the job *to your delight* through thick and thin!

You never do tire of P. A. You're just as full of that lead-me-to-it spirit at 7 a. m. as you were at 10.30 the night before! Set that down to Prince Albert quality *that's all yours for the say-so!*

And, behind quality is Prince Albert's exclusive patented process that cuts out bite and parch. That means *you can smoke* your fill of a joy'us jimmy pipe or makin's cigarettes *without a comeback!*

Just get the gladnoise of P. A. *quality*, and, P. A. *freedom from bite*—and you'll take the knock out of your smokemotor quicker than a wink!

Tell you straight, you're saying something when you demand Prince Albert, for the tidy red tin is the certificate of membership in the hugest smokefraternity the world ever knew! Smokepals by the thousand any way you travel!

Scrap-your-smoke-past! Clamp your taste-o-meter on some Prince Albert and find out at a right-pretty-quick-gait how you and P. A. will mix!

Prince Albert is sold in toppy red bags and tidy red tins; in handsome pound and half-pound tin humidors—and—in that clever, practical pound crystal-glass humidor with sponge-moistener top that keeps the tobacco in such perfect condition.

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.